THE APPLICATION OF VALUE FOCUSED THINKING TO

UTILITIES PRIVATIZATION SOURCE SELECTION

THESIS

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Abstract

The Department of Defense's utility systems have suffered from under-funding and lack of technology investment, thereby creating a service gap between these DoD systems and systems operated by commercial providers. In order to overcome this gap and refurbish their systems, the DoD has focused its efforts on privatization of these systems. Although the Air Force has published source selection guidance to aid the privatization process, the utilities privatization decision is extremely vital and "permanent" and thus warrants backup source selection methodologies.

Since awarding contracts in the utilities privatization arena requires a decision considering tradeoffs between multiple competing objectives such as economic feasibility, security, readiness, reliability, and cost, a value-focused thinking approach was used to create a structured, standardized value model taking into account the values of the United States Air Force with regard to utilities privatization. This model was then used to evaluate a set of randomly generated contractor proposals for leasing an Air Force owned electrical system and perform deterministic and sensitivity analysis on the recommended decision generated by the model.

The results of this research provide a quantitative, objective, reliable, and defendable tool for a utilities privatization source selection decision. The value model is generic enough for evaluating the source selection decision of any utility system, but is able to accommodate changes in guidance, decision makers, and other factors.

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THE APPLICATION OF VALUE-FOCUSED THINKING TO UTILITIES PRIVATIZATION SOURCE SELECTION

Chapter 1. Introduction

1.1 Introduction

Modern civilizations and their economies are built upon sufficiently developed infrastructures for the proper supply of water, gas, electricity, and other utilities. Therefore, the respective utility systems that supply and treat water and provide electricity and natural gas are intrinsically entwined with human societies and progress (de Luca, 1997). A society unable to provide these essential utilities risks losing its ability to function, thus it is imperative that effective and efficient utility systems exist.

Historically, utility systems have been held to be natural monopolies run by privately owned, regulated mega-corporations or government-run companies (Plaff, 2001). During the last 20 years, however, increasing consumption, rising costs, and ecological considerations have made it difficult for companies to meet new demands and implement technological advances; this has fueled motivation to create more efficient and cost-effective market solutions for utility systems (de Luca, 1997). Many of the privately owned mega-corporations have been deregulated to eliminate bureaucratic inefficiencies, thereby creating market competition in efforts to stimulate new technologies and investment. However, finding ways to "force" publicly held utility systems to meet increased demands while simultaneously maintaining efficiency, equity, and long-term environmental sustainability has been more troublesome because of their political

surroundings (de Luca, 1997; Plaff, 2001). Currently, one of the most popular, and some would argue most effective, market solutions for “fixing” public utility systems is privatization (Plaff, 2001). Privatization is simply the transfer of government-held systems to private (commercial) sector companies; proponents of believe private sector companies can more efficiently and effectively provide the services offered by public utilities (Prager and Desai, 1996). However, opponents of privatization assert that public administrations should avoid “knee-jerk reactions” in claiming that privatization is always more effective, more efficient, and less costly than the goods and services being provided by government entities (Prager and Desai, 1996).

1.2 Problem Background

The Department of Defense (DoD) has encountered many of the same bureaucracy-driven problems with their utility systems. The DoD’s utility systems have suffered from under-funding and lack of technology investment, which has created a perceived gap between the service provided by DoD systems and systems operated by commercial providers. The strong belief that the private sector is “inherently dynamic, productive, and dependable,” along with the high capital costs associated with bringing existing utility systems up to current technological standards, has convinced many decision makers that the private sector can provide less costly service at a higher service level than current publicly owned utilities (Barnekov and Raffel, 1990; Orwin, 1999; de Luca, 1997). Therefore, the DoD has focused on the privatization of its systems to overcome the perceived service gap (Marrs, 2003).

In December of 1997, the DoD issued Defense Reform Initiative Directive #9 (DRID #9) to direct the military services to develop a plan for privatizing all utility systems by January 1, 2000, except where privatization of a system was either not economically or not appropriate due to unique security reasons. Each service was required to outline their requirements for accomplishing utility privatization, including a timetable with internal benchmarks (Deputy Secretary of Defense, 1997). However, it was soon realized that the number of systems to be privatized and the complexity of the privatization process made this goal unrealistic. Accordingly, the DoD issued DRID #49 to extend the completion goal to September 30, 2003. It also directed the services to observe two milestone dates: a "Go/No-Go" decision for all utility systems by September 30, 2000, regarding whether or not a system was available for privatization (i.e., no unique security requirements and economically feasible), and a release of solicitations for all systems identified as available by September 30, 2001. It also set forth previously unprovided written guidance on exempting systems from privatization, competing contracts, and conducting economic analyses (Deputy Secretary of Defense, 1998).

It was soon realized that DRID #49 was overly ambitious as well. By September of 2001, more than 1,300 utility systems were under solicitation or pending the release of a Request for Proposal (RFP). The utility industry reported that this was saturating the market and decreasing effective competition for the award of these privatization efforts. The military departments concurred and the DoD responded by releasing revised guidance on utilities privatization in October of 2002. The revised guidance directed the services to have a utilities privatization (UP) evaluation done on every system by

September 30, 2005, to determine the availability of each system for privatization (Deputy Secretary of Defense, 2002). It also shifted the emphasis away from a completion date; instead, it focused on the process itself. Accordingly, the revised guidance included three interim milestones: the establishment of final internal milestones for each service by October 15, 2002; the closure of RFPs or the submittal of certificates of exemption for at least 80 percent of the systems specified as available for privatization by September 30, 2003; and finalization of Source Selection Authority (SSA) decisions or the submittal of certificates of exemption for at least 65 percent of the systems specified as available for privatization by September 30, 2004 (Deputy Secretary of Defense, 2002).

To help its personnel meet the revised UP guidance, the Air Force released its own service-specific guidance in October of 2002 in the form of the Air Force UP Policy and Guidance Manual. This guidance reviewed applicable policies, defined roles and responsibilities, and specified the utility privatization process through contract award and property transfer. The Air Force also established the Air Force Utility Privatization Executive Steering Group in May of 2003 to oversee execution of the Air Force's utility privatization program (Department of the Air Force, 2002).

To meet the interim goal required in DRID #49 of releasing Requests for Proposal (RFPs) for all available utility systems in the inventory by September 30, 2001, the Air Force released an RFP template on February 11, 2000. After its initial release, the template was amended in June of 2000 and again in February of 2003. Released by the Air Force Civil Engineer Support Agency (AFCESA), the most recent revision of the template provides a comprehensive process for preparing RFPs. It describes how a

contractor’s price schedule should be based on inputs such as the purchase price of the system, the cost of initial capital upgrades, transition costs, etc. It also covers particular descriptions, specifications, and work statements that should be included in the RFP to encompass a wide range of subjects such as: service requirements and performance standards, employees, security, rights of way, service interruption and contingencies, work order response requirements, work coordination requirements, environmental compliance, upgrades, renewals and replacements, transition plans, and specialty training requirements. The template also specifies which clauses from various regulations are considered mandatory items and identifies specific contract terms and contract administration requirements. The RFP template also lists the various representations, certifications, and statements required of the contractors. Finally, the template includes a detailed section on how a contractor should prepare its proposal (DESC, 2002).

One of the improvements included in the 2003 revision is the inclusion of instructions to the contractors on how proposals will be evaluated. The current evaluation process consists of five factors: Mission Capability, Past Performance, Proposal Risk, Socioeconomic Plan, and Price. Each of the factors, other than Price, is evaluated against a scale constructed specifically for that particular factor and receives an appropriate rating. The evaluation falls under the auspices of the Source Selection Evaluation Team (SSET), which is responsible for advising the Source Selection Authority (SSA) and Source Selection Authority Board (SSA Board) as appropriate. The SSET is also responsible for performing the comparative analysis of proposals received as well as conducting the evaluation in an impartial and equitable manner (DESC, 2002).

1.3 Problem Statement

The Air Force has published enormous amounts of guidance regarding the privatization process, but not enough focus has been placed on developing proposal evaluation tools for use in the source selection process for competitive UP situations. Although an economic feasibility program had been created and guidance was available in the Air Force UP Policy and Guidance Manual, no standardized methodology for accomplishing the award, implementation, measurement, and verification steps exists. The release of the 2003 revisions to the RFP template introduced a methodology for source selection evaluation. This methodology is a step in the right direction; however, it does not eliminate a large amount of the subjectivity present in the decision making process and it has no quantitative basis. Additionally, it does not incorporate some of the findings from recent UP research. One of the most common lessons learned in privatization efforts around the world is that a reliable, objective, repeatable, and defendable source selection process is absolutely necessary (Orwin, 1999; de Luca, 1997). Orwin (1999) states that not only is a standardized source selection process needed but, because of the enormous potential impact of these contracts, which are awarded for timeframes of 10 to 50 years, a backup (or secondary) source selection tool should also be used to ensure the "accuracy" of the primary tool (Orwin, 1999).

Since the Air Force has been mandated to accomplish utilities privatization, a definitive and more comprehensive process is needed to ensure that base utilities privatization teams have a reliable, objective, repeatable, and defendable evaluation technique for awarding contracts. Therefore, the purpose of this thesis is to pursue the development of a standardized model that can be used as a secondary source selection

decision support tool in any competitive utilities privatization scenario in the Air Force. Because of time and scope limitations, however, this portion of the research will be limited to developing a model for electrical system UP source selection decisions.

1.4 Research Objective and Questions

Awarding contracts in the utilities privatization arena requires a decision that considers tradeoffs between multiple competing objectives such as economic feasibility, security requirements, readiness requirements, reliability, service, and cost. A key to this decision making process is whether a structured technique exists that takes into account the values (information, opinions, and preferences) of the decision maker (Kirkwood, 1997). One particularly effective method of creating this structured tool is through the use of value-focused multiple objective decision analysis or Value Focused Thinking (VFT). Since VFT provides an objective view of what is often a subjective decision, it will allow a hierarchical structuring of the values that the Air Force holds with regard to utilities privatization and facilitate an evaluation of the contractor proposals under consideration based on that value structure. Therefore, the objective of this thesis will be to develop a VFT model for utilities privatization as a reliable, objective, repeatable, and defendable evaluation tool that can be used universally by Air Force bases when making source selection decisions.

To achieve this objective, the following research questions will be addressed during this research:

1. What values does the Air Force hold regarding utilities privatization? What measures can be developed and used to accurately represent and evaluate those values?

2. Which values affect the contract award decision most? Will this hold true at all bases and throughout the process at each base?

3. Will one set of values hold true for all utility systems (i.e., electrical, water, wastewater, and natural gas)? Can the value hierarchy be held constant with changes made only in the measurements, value functions, or weights for each system evaluation?

1.5 Methodology

In this thesis research, Value Focused Thinking will be used in its "traditional" sense to evaluate alternatives (contractor proposals) by using a value hierarchy to aid in making a decision (source selection). For this specific problem, the ten-step VFT methodology proposed by Shoviak (2001) will be used to develop the mathematical model with the aid of the Air Force Civil Engineer Support Agency utilities privatization team. Since the model is based on values inherent to the decision maker, validation of the model is accomplished by the decision maker throughout the model development process. To further validate the model, it will be used to evaluate a notional data set that is randomly generated specifically for the purposes of this research. Performing post-analysis on the model's recommended actions regarding this data set will provide validation and insight into the usefulness of the model.

1.6 Scope and Limitations of Research

The intended scope of this research was to create a standardized Value Focused Thinking model that will allow the systematic and objective evaluation of proposals submitted by contractors competing for award of utility privatization contracts. The

model will provide a tool to evaluate source selection decisions for electrical utility systems at Air Force installations. Further research may have to be performed to convert the model into one that is more useful for other utility systems (water, wastewater, and natural gas).

Through research completed at AFIT and by the AFCESA Utilities Privatization Team, it was discovered that no active, reserve, or air national guard base has privatized their electrical system using the current RFP solicitation process. Furthermore, at the time of this research no bases were in the process of privatizing their electrical systems. Since it was impossible to test the developed model against actual proposals, it was tested against notional data sets (proposal scores) generated using a random number generator.

1.7 Document Structure

There are four remaining chapters in this thesis. Chapter 2, Literature Review, provides an in-depth presentation of the existing knowledge base and consensus of thought regarding utilities privatization and Value Focused Thinking. The chapter will allow the reader to develop a basic understanding of the concepts critical to this research. Chapter 3, Methodology, will focus on the technique of developing and using a VFT model to evaluate the research objective specified in Chapter 1. It will also explain how the post-award analysis was conducted using the model's results as well as explain the validation process inherent to VFT. Chapter 4, Data Analysis, will review the results of the post-award analysis conducted on the notional data. It will also explain the impact of this analysis on the model itself. Chapter 5, Results and Conclusions, will summarize the results of the research effort and present the resulting conclusions. It will also present

recommendations for implementation of this model and for further research within this field.

Chapter 2. Literature Review

This chapter provides an in-depth presentation of the existing knowledge base and consensus of thought regarding utilities privatization and Value Focused Thinking. The chapter begins by defining privatization not only in the private and government sector, but also in terms of this research effort. This chapter also includes a discussion of the reasons privatization is being used, concerns about privatization, and appropriate circumstances for the use of privatization. The history of utilities privatization in the Department of Defense (DoD) and Air Force is also reviewed, along with pertinent policies and a discussion of the current Air Force source selection process. Finally, Value Focused Thinking is described in terms of Decision Support Systems and models.

2.1 Defining Privatization

Before developing a valid source selection model, a good working definition of privatization is critical to understanding this research effort. Defining privatization is more difficult than it sounds, as the term has been used to describe the following types of typical privatization strategies (Barnekov and Raffel, 1990):

1. Shifting the public provision of goods or services to private hands through contracting out or issuing vouchers but still providing public financing.
2. Complete withdrawal of public agencies from specific goods or services with the supposition that private institutions such as firms, families, or voluntary organizations will supply those goods or services.
3. The sale of public assets.
4. Deregulation (the removal of governmental controls on the private provision of a good or service).

In fact, although privatization is often referred to and discussed as one continuous process, the concept is best defined as a group of policies and techniques that are designed and initiated to promote private sector involvement in the administration or financing of goods and services that are traditionally viewed as the responsibility of the government (Auger, 1999). Table 1 shows how privatization efforts have been initiated by state governments in the past.

Table 1. Methods Used in Privatization Activities Reported by States (Auger, 1999)

Contracting	80.0%
Grants	5.7%
Public-private Partnerships	4.3%
Volunteerism	1.8%
Vouchers	0.7%

Privatization can also be looked at from the viewpoint of two competing tactics: (1) using the assumed inherent efficiency of the private marketplace to improve the dispersion of goods or services or (2) reducing or ending public provision and support for specific goods and services completely (load shedding) (Barnekov and Raffel, 1990). Sundquist (1984) points out that the first of these strategies is the elimination of what

“may be the easiest part – the doing. The conceiving, planning, goal-setting, standard-setting, performance-monitoring, evaluating, and correcting all remain within the government.” This transference tactic accurately describes the process currently used by the Air Force to privatize its utility systems. The second strategy occurs when government entities remove themselves partially or completely from the role of purchaser, planner, goal-setter, performance monitor, etc., for a specific good or service area (Kolderie, 1986). Some supporters of privatization call this the “real” privatization because it eliminates “public spending coalitions” and political support for growth in government roles (Butler, 1985). For this method to be considered privatization, other proponents argue that the government or public entity must ensure that a private sector replacement will be available and that the original good or service is not simply being eliminated (Sundquist, 1984).

As stated in Chapter 1, privatization can be generally defined as the transfer of government-held systems to private (commercial) sector organizations. This transfer can be complete (e.g., production, conveyance, and billing) or partial (e.g., production only). In more specific terms for the purposes of this research effort, privatization will be considered as the transfer of government-held utility systems (i.e., electrical, water, wastewater, and natural gas) to private (commercial) sector organizations with the financing and oversight of the systems remaining the responsibility of the government (i.e., Air Force).

2.2 Why Privatization?

Public utilities have been under-funded and under-managed for too many years and have grown too dilapidated and costly for governments to bring back up to satisfactory operational status under normal funding scenarios (Orwin, 1999; de Luca, 1997). At the same time, the public is clamoring for a less prominent role from government to reduce the bloated bureaucracies that have become commonplace (Wallin, 1997). This situation is causing government managers at every level (national, state, and local) to realize that they must implement systems that not only cut operational and capital costs, but also maintain service levels and have more than a “surface attractiveness” and simple short-term advantages (Auger, 1999). Throughout the world, privatization has been hailed as the most efficient means of creating market solutions to what have become complacent, ineffective, and expensive publicly held utility systems (Orwin, 1999; de Luca, 1997; Plaff, 2001).

Most people accept the potential for privatization to yield significant social improvements and benefits by utilizing private sector financial and organizational resources to “supplement or replace” publicly provided goods and services (Prager and Desai, 1996). The strong belief that the private sector is “inherently dynamic, productive, and dependable,” convinces many decision makers that the private sector can and will provide less costly service at a higher service level than current publicly owned utilities (Barnekov and Raffel, 1990). Another factor leading to this belief is the high capital cost associated with bringing existing utility systems up to current technological standards. Often, without expenditures in the millions or billions of dollars, these systems stand no chance of being brought up to proper working condition (Orwin, 1999; de Luca, 1997).

Since private companies often have more options for financing these capital investments, proponents of utilities privatization point to high capital costs as a strong incentive for publicly owned systems to change hands.

Supporters of privatization also point out that without the need to support these inefficient systems financially, which often operate at substantial losses, public (governmental) expenditures and taxes can be greatly reduced. Additionally, revenues can be generated through the sale and transfer of the utility systems as well as the infrastructure and assets associated with the systems. Utilities privatization supporters are also quick to mention that the operation and funding of publicly held utility systems are extremely politicized. This faction touts privatization as a means to both depoliticize the management and financing of these systems and eliminate the power of public sector unions (Barnekov and Raffel, 1990).

2.3 Concerns with Privatization

Even proponents of privatization, however, admit that public administrations should avoid “knee-jerk reactions” in claiming that privatization is always more effective, more efficient, and less costly than the goods and services being provided by government entities (Prager and Desai, 1996). In fact, most opponents of privatization consider the belief in long-term advantages of privatization as an extremely naïve viewpoint, arguing that as the sole or major purchaser of goods and services from many of the companies involved with privatization efforts, public entities may become hostage to the inefficiencies and bureaucracies of these “single seller” monopolies. In essence,

privatized utility systems could end up in the same place from which they started, with high prices and low service levels (Bailey, 1987).

Another argument presented against privatization is the specter of client "creaming" whereby private corporations, in order to show good results, tend to provide services only to the easiest, most predictable customers, while ignoring the "difficult and unprofitable" ones (Barnekov and Raffel, 1990; Orwin, 1999). Many people fear that this will simply enlarge the rift between the well-off and the poor in terms of the quality of goods and services available (Barnekov and Raffel, 1990; Orwin, 1999). This situation has been seen in many of the South American countries that have initiated privatization efforts (Orwin, 1999).

Other opponents point to the threat that privatization poses in regard to corruption. Once the private sector becomes involved with government and gains the ability to influence political decisions, exploit contracts, and create cost overruns, the potential for fraud, bribery, and kickbacks exists. Americans have seen this occur in their defense industry, highway construction and maintenance industry, and their medical care system (Barnekov and Raffel, 1990). In order to prevent this problem, more and more funds must be spent to monitor and regulate the corporations in the privatization process (Barnekov and Raffel, 1990). Although competition, the main market factor that should provide success in privatization, usually provides benefits initially, those benefits may be short-lived (Kohn, 1986). This is especially true with regard to the long-term contracts (10-50 years) that government entities typically pursue with privatization efforts (Hodge, 1999).

Opponents also argue that one of the most worrisome problems with privatization from the social standpoint is that although cost savings and benefits may be realized at the organizational level, other concerns are created at higher levels. These opponents state that privatizing a good or service results in lower wage levels, greater use of part-time workers with fewer fringe benefits, and higher unemployment numbers. These all create a social problem that drains from the greater good and imposes monetary and life problems on public employees (Barnekov and Raffel, 1990).

This concern with the social impacts of privatization is one of the larger parts of the argument against it. While proponents point to the economic good resulting from privatization, opponents focus on other values, such as "accountability, equity, service quality, and governmental capacity." Although competition in the private marketplace provides obvious potential benefits, it also creates a situation in which private firms have an agenda that does not necessarily amount to creating the best social environment possible. While the government has a social responsibility to provide for its citizens and conduct itself in an open and fair manner, private corporations are not held to the same standard (Starr, 1987).

2.4 When Privatization Should Be Used

All of the arguments against privatization indicate that a well-defined and effective system for awarding, implementing, monitoring, and evaluating a privatization effort is fundamental to the success of the endeavor. These arguments also illustrate that the initial decision on whether or not to privatize must be based on a solid evaluation

process. However, much of the current argument on whether or not to privatize a system revolves only around cost effectiveness.

A great deal of this emphasis on cost is driven by the relative ease of obtaining and comparing cost data, especially when compared to the often difficult task of obtaining service level data (Barnekov and Raffel, 1990). Prager and Desai (1996) state that one of the key points that emerged from their study on privatizing local government operations was that making the right decision on privatizing or not requires “an approach that focuses on and appropriately interprets private sector – public sector cost-effectiveness comparisons” (Prager and Desai, 1996). They also state that although many organizations evaluating the cost-effectiveness of privatization ignore cost tradeoffs, the Office of Management and Budget’s Circular A-76 is “as complete and pragmatic a document as is likely to appear” for comparing costs. Table 2 illustrates the complexity of the cost comparison performed with the A-76 process.

The A-76 process applies to work that is a government function but is “contracted out” for accomplishment by a private entity. However, Prager and Desai (1996) also argue that the A-76 process is flawed because it bases the award decision on low-cost alone. This lack of consideration for other areas such as efficiency or productivity can cause “woefully inappropriate policy decisions” (Prager and Desai, 1996). These same concerns can be transferred directly to most privatization efforts, including utilities privatization, and highlight the need for a source selection tool that examines tradeoffs rather than focusing on cost alone.

Table 2. In-House Versus Contract Performance Cost Calculations
(Prager and Desai, 1996)

In-House Performance Costs	Contractor Performance Costs
Personnel	Contract Price
Materials and Supplies	Contract Administration
Other Specifically Attributable Costs	Additional Costs
Overhead	On-Time Contract Conversion Costs
Capital	Gain (Loss) on Disposal or Transfer of Assets
One-time Conversion Costs	Federal Income Tax Deduction
Additional Costs	Total
Total	

Most of the emphasis for privatization revolves around a reduction in cost with no related reduction in service levels. This focus dictates that proper baseline measurements must be taken and that effective comparison areas are imperative. The A-76 Circular states that the "contracting out process cannot get off the ground without a clear Performance Work Statement" (Prager and Desai, 1996). Similarly, many studies show that the best candidates for privatization are government functions that have identifiable and specific "service tasks and performance expectations (Auger, 1999; Barnekov and Raffel, 1990; Dilger, Moffitt, and West, 1997; and Wallin, 1997). Table 3 lists various criteria that may rule out privatization as an option.

Table 3. Conditions and Criteria That May Dictate Against Contracting Out
(Wallin, 1997)

1. When other privatization strategies are deemed to be more effective

2. When services cannot be effectively measured as to cost, quality, process, and outcomes

3. When done in conjunction with services cuts

4. When privatization is explicitly forbidden by existing collective bargaining agreements, or when costs outweigh benefits

5. For so-called “core” functions of government, e.g., policy-making or enforcement functions

6. When public ends (i.e., equity access, antidiscrimination) are ill-served by private provision

7. When services are not readily available from the private sector

8. Where legal barriers exist

Some government services, such as human services and education, have not been investigated as heavily for privatization because the results are difficult to quantify. However, other government services have been more aggressively targeted for privatization because of the ease in identifying effective measurement devices. Table 4 shows the ten most privatized services in America in 1995. The privatization of utilities systems would appear to fit into this group exceptionally well.

Table 4. Ten Most Privatized Services in 1995
(Dilger, Moffitt, and West, 1997)

1. Vehicle Towing/Service
2. Solid Waste Collection
3. Building Security
4. Street Repair
5. Ambulance Services
6. Printing Services
7. Street Lighting/Signals
8. Drug/Alcohol Treatment
9. Employment and Training
10. Legal Services

2.5 Utilities Privatization Within the DOD

The current Department of Defense vision for their utility systems centers on providing or acquiring adequate funding and management to bring all systems up to standards by 2010. In order to incorporate private sector innovations and efficiencies, the DoD prefers utilities privatization as their method of modernization and sustainment (Marrs, 2003). The DoD, driven by the current state of world affairs (Operations ENDURING FREEDOM, IRAQI FREEDOM, etc.), is also trying to realign itself around its core competencies: Air and Space Superiority, Global Attack, Rapid Global Mobility, Precision Engagement, Information Superiority, and Agile Combat Support. Many DoD

leaders feel that maintaining and operating utility systems does not fall within any of these core competencies. Once again, privatization has been targeted as the preferred method of retaining quality, affordable service while reducing costs (Marrs, 2003).

This vision began to take shape in December of 1997 when Defense Reform Initiative Directive #9 (DRID #9), Privatizing Utility Systems, was issued to the military services (Army, Navy, and Air Force). DRID #9 directed the services to develop and implement plans for privatizing all of their utility systems (defined as electric, water, waste water, and natural gas) by January 1, 2000, except where privatization of a system was either not economically feasible or not appropriate due to unique security reasons. DRID #9 also directed the establishment of "uniform criteria for the military departments to apply" in determining whether or not it was feasible to privatize a system. The services were also instructed to establish a timetable with benchmark milestones to meet no later than 13 March, 1998 (Deputy Secretary of Defense, 1997).

In January of 1998, DRID #21, Formation of the Defense Energy Support Center (DESC), was put into effect. This initiative, along with redesignating the Defense Fuel Supply Center as the DESC, directed the DESC to develop plans to execute regional demonstrations of total energy management and consolidate the DoD's regional energy efforts. Part of this responsibility was to assist the services with privatizing the utility-related infrastructure that was initially associated with the regional demonstrations (Deputy Secretary of Defense, 1998).

By December of 1998, DRID # 49, Privatizing Utility Systems, was issued as the DoD leadership realized that the number of systems to be privatized and the complexity of the privatization process made the goals outlined by DRID # 9 unrealistic.

Accordingly, DRID #49 extended the completion goal to September 30, 2003. It also directed that the services observe two milestone dates: a "Go/No-Go" decision for all utility systems by September 30, 2000, regarding whether or not a system was available for privatization (i.e., no unique security requirements and economically feasible), and a release of solicitations for all systems identified as available by September 30, 2001 (Deputy Secretary of Defense, 1998). DRID #49 also required the military services to submit their revised privatization plans by December 23, 1998. These plans were to include an inventory of all current utility systems, including those that were on the exemption list. The plans were to also include a detailed timeline for each system showing four key milestones: Notice of Intent, Study Complete, Solicitation, and Contract Award. A stipulation was also included that called for the services to submit quarterly reports summarizing each system's progress, problems encountered, and ways to ensure efficiency and eliminate barriers within the privatization process (Deputy Secretary of Defense, 1998). It also set forth written guidance on exempting systems from privatization, competing contracts, and conducting economic analyses. Finally, DRID #49 also directed action be taken to determine the amount of legislative relief required on two particular obstacles: the 10-year limitation on utility service contracts and the tax treatment of utility system conveyances (Deputy Secretary of Defense, 1998).

The DoD leadership soon realized that the time requirements outlined in DRID #49 were also too restrictive. Over 1,300 utility systems were under solicitation or pending the release of a Request for Proposal (RFP) in September of 2001. The utility industry notified the DoD that this was saturating the market and decreasing effective competition (thus eliminating many of the economic advantages of privatization). The

military departments concurred with the utility industry report, causing the DoD to release revised guidance on utilities privatization in October of 2002 (Deputy Secretary of Defense, 2002).

The new guidance covered all aspects of the privatization process and directed the services to complete a utilities privatization (UP) evaluation on every system in the DoD inventory by September 30, 2005; the only exceptions were utility systems designated for closure under a base closure law. It also required the services to submit a revised privatization plan and schedule for all systems by October 23, 2002 (two weeks after receipt of the memo). Thereafter, the military departments were to submit an annual update and quarterly status reports showing a comparison of forecast timelines to actual timelines (Deputy Secretary of Defense, 2002).

The revised guidance also included three interim milestones: the establishment of final internal milestones for each service by October 15, 2002; the closure of RFPs or submittal of certificates of exemption for 80 percent of the systems specified as available for privatization within each component by September 30, 2003; and finalization of Source Selection Authority (SSA) decisions or submittal of certificates of exemption for 65 percent of the systems specified as available for privatization within each component by September 30, 2004 (Deputy Secretary of Defense, 2002). The revised guidance represented a move away from strict deadlines and refocused efforts towards interim milestones. This shift appeared to show recognition by the DoD leadership that a more thorough and efficient privatization effort could be realized if the process was not rushed.

2.6 Utilities Privatization Within the Air Force

In the meantime, the United States Air Force (USAF) leadership struggled to meet all of the imposed deadlines and adjust accordingly to each new piece of guidance. The first milestone the Air Force met was the requirement outlined in DRID #49 for a "Go/No-Go" decision on all utility systems by September 30, 2000. The Air Force concluded that 513 systems were suitable for privatization; 434 of these systems were to be considered "Go" and 79 were to be considered "No Go" (Secretary of the Air Force, 2000).

In response to the "Revised Utilities Privatization (UP) Program Guidance" Package released on October 9, 2002, the USAF released internal guidance on October 23, 2002, to help its personnel meet the revised Utilities Privatization (UP) guidance provided by the DoD. It covered the UP policies, the roles and responsibilities of players in the process, and the entirety of the process up to solicitation and award of the contract and property transfer. The Air Force also established the Air Force Utility Privatization Executive Steering Group in May of 2003 to provide guidance on and oversee execution of the Air Force's utility privatization program. The steering group was tasked with three specific functions: advocating the use of USAF and DoD resources for funding of privatization efforts, monitoring and providing necessary support to integrated process teams and other teams in executing actual projects, and reviewing and coordinating on UP progress reports (Department of the Air Force, 2002).

2.7 Current Source Selection Process

To meet the interim goal of releasing Requests for Proposal (RFPs) for all applicable utility systems in the inventory by September 30, 2001, the Air Force released an RFP template on February 11, 2000. After its initial release, the template was amended in June of 2000 and again in February of 2003. Released by the Air Force Civil Engineer Support Agency (AFCESA), the most recent revision of the template provides a comprehensive process for preparing RFPs. It describes how a contractor's price schedule should be based on inputs such as the purchase price of the system, the cost of initial capital upgrades, transition costs, etc. It also covers particular descriptions, specifications, and work statements that should be included in the RFP to encompass a wide range of subjects including: service requirements and performance standards, employees, security, rights of way, service interruption and contingencies, work order response requirements, work coordination requirements, environmental compliance, upgrades, renewals and replacements, transition plans, and specialty training requirements. The template also specifies which clauses from various regulations are considered mandatory items and identifies specific contract terms and contract administration requirements. The RFP template also lists the various representations, certifications, and statements required of the contractors. Finally, the template includes a detailed section on how a contractor should prepare its proposal (AFCESA, 2003).

One of the improvements included in the 2003 revision is the inclusion of instructions to the contractors on how proposals will be evaluated. Shown in Figure 1, the evaluation process is very detailed; however, the instructions do not specify the criteria to be used in evaluating proposals. Therefore, this research is focused on creating

an objective, repeatable methodology for comparing and identifying competitive proposals, establishing areas for clarifications or discussions, and/or differentiating between proposals for final award.

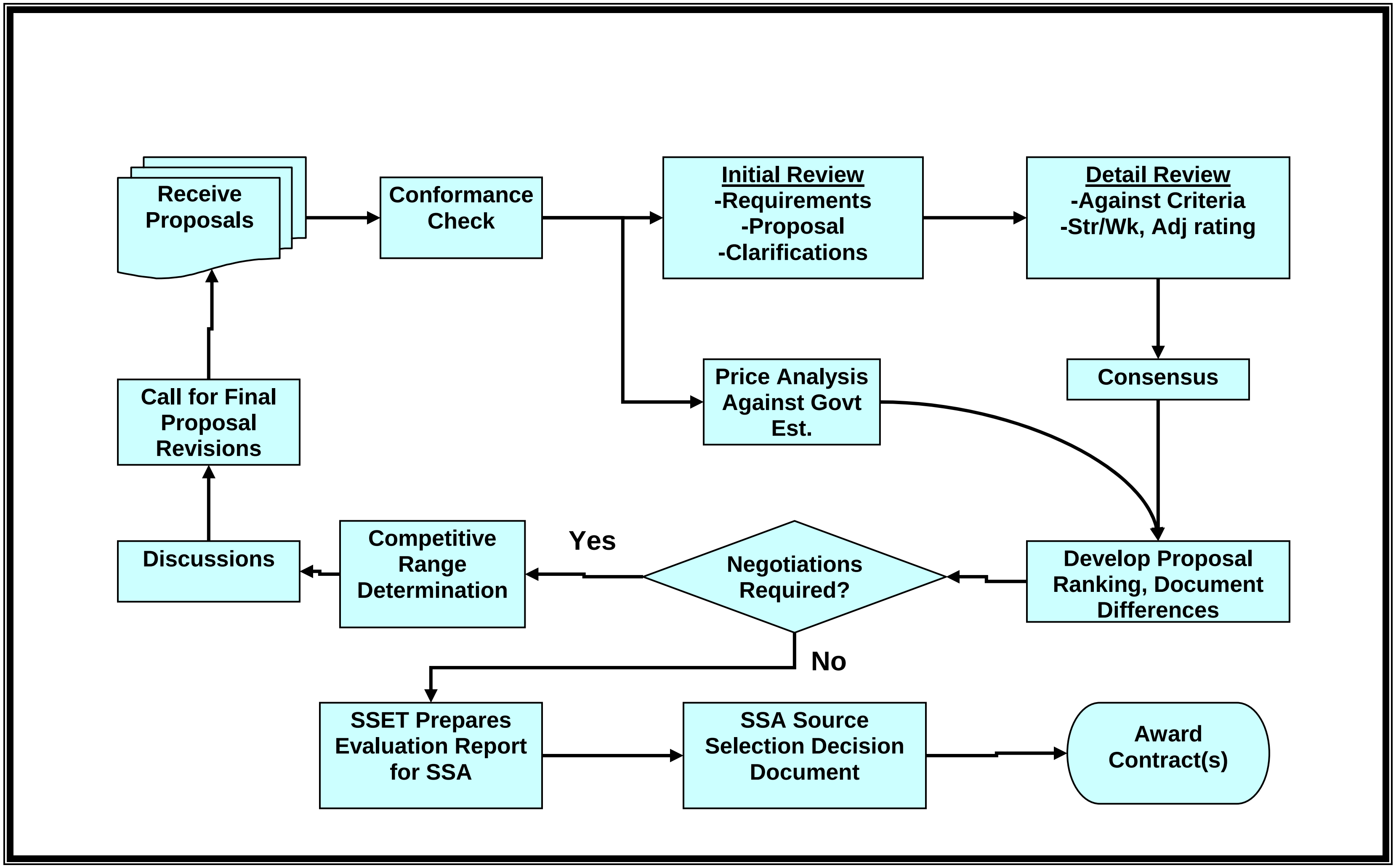


Figure 1. Overall Evaluation Process Outlined in RFP Template
(DESC, 2002:75)

During the source selection process, the current evaluation tool evaluates proposals against five factors: Mission Capability, Past Performance, Proposal Risk, Socioeconomic Plan, and Price. During the evaluation, Mission Capability, Past Performance, and Proposal Risk are considered the most important factors and are accorded equal importance. The Socioeconomic Plan is ranked as the least important of the five factors. Furthermore, the combined non-cost factors are considered to be significantly more important than price (DESC, 2002).

Mission Capability and Proposal Risk are each broken down further into five sub-factors: Service Interruption/Contingency Plan, Quality Management Plan, Capital Upgrades and Renewals and Replacements Plan, Operational Transition Plan, and Financial Capability. The Service Interruption/Contingency Plan and Quality Management Plan are considered the most important sub-factors and are accorded equal importance. The remaining three sub-factors are equally important; however, each is also considered less important than the Service Interruption/Contingency Plan and Quality Management Plan sub-factors (DESC, 2002).

Each of the four factors, other than Price, is evaluated against a scale constructed specifically for that particular factor and receives an appropriate rating. The ratings and definitions for these factors are defined in Tables 5 through 8. The evaluation itself is accomplished by four sub-teams: Technical/Cost Realism Evaluation Team, Past Performance Team, Price Analysis Team, and the Socioeconomic Team. These teams fall under the auspices of the Source Selection Evaluation Team (SSET), which is responsible for advising the Source Selection Authority (SSA) and Source Selection Authority Board (SSA Board) as appropriate. The SSET is also responsible for

performing the comparative analysis of proposals received as well as conducting the evaluation in an impartial and equitable manner. The evaluation considers tradeoffs among price and non-price factors by applying weights to each of the factors. However, price is not included in the weighting; instead, it is simply evaluated for reasonableness and realism, whether it represents a clear understanding of the requirements, and accurately reflects the market conditions and competition. Price is also compared against the government's estimated "Should Cost" of operating the utility system, which is the amount that the government should have been spending to maintain and update the system to keep it at or above industry standards. This is different than the actual amount that the government was spending on the system. The difference between the "should" and actual costs represents the under-funding that caused the deficiencies the government is trying to overcome with privatization. As long as the offeror's proposed price is lower than the government's "Should Cost", a proposal is considered for further evaluation.

Table 5. Mission Capability Ratings
(DESC, 2002:86)

Rating	Definition
Exceptional (Blue)	Exceeds specified minimum performance or capability requirements in a way beneficial to the Government
Acceptable (Green)	Meets specified minimum performance or capability requirements necessary for acceptable contract performance
Marginal (Yellow)	Does not meet some specified minimum performance or capability requirements necessary for acceptable contract performance, but any proposal inadequacies are correctable
Unacceptable (Red)	Fails to meet specified minimum performance or capability requirements. Proposal with an unacceptable rating are not awardable

Table 6. Past Performance Ratings
(DESC, 2002:115)

Rating	Definition
Exceptional / High Confidence	Based on the Offeror’s performance record, essentially no doubt exists that the Offeror will successfully perform the required effort.
Very Good / Significant Confidence	Based on the Offeror’s performance record, little doubt exists that the Offeror will successfully perform the required effort.
Satisfactory / Confidence	Based on the Offeror’s performance record, some doubt exists that the Offeror will successfully perform the required effort.
Marginal / Little Confidence	Based on the Offeror’s performance record, substantial doubt exists that the Offeror will successfully perform the required effort. Changes to the Offeror’s existing processes may be necessary to achieve contract requirements.
Unsatisfactory / No Confidence	Based on the Offeror’s performance record, extreme doubt exists that the Offeror will successfully perform the required effort.
Neutral / Unknown Confidence	No performance record identifiable (see FAR 15.305[a][2][iii] and [iv]).

Table 7. Proposal Risk Ratings
(DESC, 2002:87)

Rating	Definition
High Risk	Likely to cause significant disruption of schedule, increased cost, or degradation of performance. Risk may be unacceptable even with special contractor emphasis and close government monitoring.
Moderate Risk	Can potentially cause some disruption of schedule, increased cost, or degradation of performance. However, special contractor emphasis and close government monitoring will probably be able to overcome difficulties.
Low Risk	Has little potential to cause disruption of schedule, increased cost, or degradation of performance. Normal contractor effort and normal government monitoring will probably be able to overcome difficulties.

Table 8. Socioeconomic Plan Ratings
(DESC, 2002:116)

Rating	Definition
Excellent	Offeror's plan addresses all seven items required by the solicitation , OR Offeror is a large business and has submitted a socioeconomic statement as well as an approved subcontracting plan that sufficiently addresses all seven items required by the solicitation, OR Offeror is a small business
Very Good	Offeror's proposal contains at least five items required by the solicitation, OR Offeror is a large business and has submitted an approved subcontracting plan
Good	Offeror's proposal contains at least three items required by the solicitation, OR Offeror's method of securing gas supplies results in there being no subcontracting opportunities under this proposal (e.g., offeror owns its own production and/or has pre-existing transportation agreements)
Poor	Offeror fails to submit information that satisfies any of the requirements listed above (applicable to large businesses)

2.8 A Distinct Need for a Definitive Air Force Source Selection Process

Awarding contracts in the utilities privatization arena requires a decision that considers tradeoffs between multiple competing objectives such as economic feasibility, security requirements, readiness requirements, reliability, service, and of course cost. As with most decisions involving tradeoffs, it is helpful to have a structured, standardized technique. The methodology outlined in the current RFP template is a step in the right direction; however it has two serious flaws: it does not eliminate subjectivity and it is not based on a quantitative comparison of the proposals.

Although the evaluation method currently in use attempts to eliminate subjectivity by creating scales upon which four of the evaluation factors are "graded," three of the scales are not based upon repeatable scoring techniques. The ratings assigned to the Mission Capability Factor, Proposal Risk Factor, and Past Performance Factor are based on the evaluation team's opinions regarding the appropriate category for each proposal. The lack of specificity within each of the category definitions for these three factors might result in the team choosing the best of several bad choices, rather than realizing they have several proposals that should not even be considered without resubmission. These "soft" definitions make it difficult for the teams to replicate their scoring since the evaluations are based heavily on opinion and cross-comparison, which can change every time the proposals are evaluated.

However, the more critical flaw of the current evaluation process is the fact that there is no quantitative comparison capability. Instead, the ratings assigned to the various factors are compared on a subjective basis. By not quantitatively defining weights within the model and instead using ambiguous terms such as most important and less important,

the evaluation process becomes subjective at the highest level of comparison. Without this quantifiable, meaningful comparison, defensibility of the evaluation is virtually eliminated.

Another sub-flaw of this tool is that by evaluating the proposals at such high levels and only breaking it down into five factors, the amount of information that must be evaluated against each of the already subjective scales is staggering. A much more effective and meaningful comparison could be obtained by evaluating at the lower levels of the proposals. The current methodology attempts this by breaking mission capability and proposal risk into subfactors (Service Interruption/Contingency Plan, Quality Management Plan, Capital Upgrades and Renewals and Replacements Plan, Operational Transition Plan, and Financial Capability), but these subfactors defined are still such enormous categories to evaluate that they do not facilitate making the evaluation objective.

Despite these flaws, the privatization of a utility system is a very permanent undertaking. Contracts are usually signed for time periods of 10 to 50 years. Even if a contractor was to fail or be released from the contract for poor performance, it would be nearly impossible for a DoD installation to reassume responsibility for the operation of the system. Therefore, the permanency of the privatization decision makes it essential to have good decision support and insight. To obtain adequate information about the source selection decision being made, it is often necessary and useful to have more than one decision evaluation process. One of the most common lessons learned in privatization efforts around the world is that a reliable, objective, repeatable, and defendable source selection process is absolutely necessary (Orwin, 1999; de Luca, 1997). Orwin (1999)

states that not only is a standardized source selection process needed, but because of the enormous potential impact of these contracts, a backup (or secondary) source selection tool should also be used to ensure the "accuracy" of the primary tool (Orwin, 1999).

2.9 Value Focused Thinking

2.9.1 Decision Support Systems

Decision makers evaluating the privatization of utility systems under their control are faced with an incredibly difficult and complex decision. As previously discussed, awarding contracts in the utilities privatization arena requires a decision that considers tradeoffs between multiple competing objectives. The priority or weight that individual tradeoffs receive can become very subjective. However, a decision of such magnitude and long lasting consequence as awarding a utilities privatization contract needs to be assessed as objectively as possible. One thing that might help is to follow a structured decision making process (Ragsdale, 2001). By following a structured process, such as a Decision Support System (DSS), the decision maker is much more likely to fully understand the decision being made as well as choose the best alternative.

2.9.2 Models

Most DSS models consist of three basic components: data collection, a model, and presentation (Post and Anderson, 2003). The most important, yet most difficult, component is the creation of the model. However, the difficulty of modeling the problem is far outweighed by the benefits gained. Models represent a more economical means of replicating and testing decisions; it is usually more feasible to implement and evaluate a model than test the real-life systems using a trial-and-error methodology. Models can

also be used to evaluate literally thousands of scenarios and can be tested for sensitivity; therefore, they offer extremely valuable insight and understanding into the decision (Ragsdale, 2001). Models also help eliminate bias and common errors by tempering the tendency of decision makers to “fly by the seat of their pants” and use “rules of thumb” (Post & Anderson, 2003).

Most conventional approaches to making decisions focus on alternatives. These approaches are often lumped into what is termed Alternative Focused Thinking (AFT). AFT is typically what most decision makers use when confronted with a problem; it is essentially identifying the available alternatives and evaluating those alternatives based on their respective merits as shown in Figure 2. This typically results in the evaluation of alternatives that are easily identifiable and the selection of the “least worst” alternative. However, these alternatives are often relevant only because they are a means to achieving the decision maker’s values (Keeney, 1993). Keeney argues that AFT is reactive, not proactive, and puts the cart of alternative identification before the horse of value articulation (Keeney, 1994).

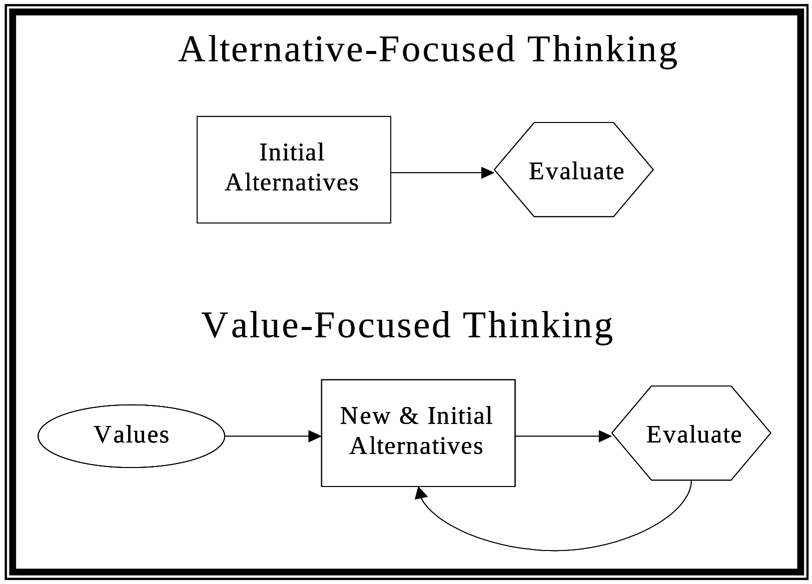


Figure 2: Alternative and Value Focused Thinking Approaches
(Katzer, 2002:27)

Value Focused Thinking (VFT), however, provides a structured, standardized technique that takes into account the values (information, opinions, and preferences) of the decision maker (in this case the United States Air Force) (Kirkwood, 1997). VFT allows decision makers to define what they value and what is fundamentally important in a specific decision situation (Keeney, 1994). These values should be the driving force in the decision making process. They allow the decision maker to identify alternatives that more completely and satisfactorily match their fundamental values.

VFT is a systematic procedure for focusing the decision maker on the core activities in solving a decision problem. VFT can often take a subjective, imprecise, and potentially confusing decision problem and allow the user to objectively weigh the

problem against their values to give the decision maker focused insight and facilitate a better decision. VFT also helps the decision maker discover hidden objectives, leads to more productive information collection, improves communication between concerned parties, facilitates stakeholder involvement, and enhances the "coordination of interconnected decisions" (Keeney, 1994).

By employing the VFT methodology, it is possible to create a quantitative structuring of the Air Force's values regarding utilities privatization and then evaluate the source selection decision based on that value structure. The utilities privatization award decision consists of competing objectives and hard to define goals and measures; however, the VFT process will allow these hard to define goals and measures to be converted into clear objectives; thereby making it possible to determine an informed, comprehensive, and defendable decision that accounts for the multiple competing objectives (Katzer, 2002). For this research, the ten-step VFT methodology outlined by Shoviak (2001) was used to develop the mathematical model with a representative from the Air Force Civil Engineer Support Agency utilities privatization team serving as the primary decision maker (PDM).

2.9.3 VFT Ten Step Process

2.9.3.1 Step 1 – Problem Identification

Although seemingly very simple and straightforward, this step can be deceiving since it is often assumed that the fundamental decision being considered is fully known and understood. However, this step is by far the most critical since there is typically only general knowledge available regarding the problem. Therefore, it is imperative that the decision maker and all involved in the process properly identify, define, and understand

the problem being addressed. First and foremost, it is extremely important the decision maker confirm that an actual decision to be evaluated exists.

Proper completion of this step allows the decision maker to fully understand the decision context, objective, and possible directions/preferences of the stakeholders involved. If the wrong problem is addressed, then the entire resulting effort can go in the wrong direction and result in wasted time and effort. A fully defined objective question allows everyone involved in the decision process to fully grasp what the decision entails. By emphasizing the definition of the problem, the decision maker can help ensure that the outcome of the decision analysis is ultimately useful.

2.9.3.2 Step 2 – Value Hierarchy Construction

A value hierarchy is a graphical representation of the decision maker's values with respect to the decision being made. Value hierarchies allow the decision makers and those involved in the decision process to visualize their values and better understand how the ensuing value system influences the decision process. This visualization process allows the stakeholders involved to not only solidify their values but also to evaluate the thoroughness of the value set depicted.

Although the values portrayed in the value hierarchy are determined by the decision maker (or a chosen proxy), there are several methods to facilitate the elicitation of the values. Most VFT models are created with a top-down approach, which recognizes the lack of clear alternatives and allows the identification of additional alternatives. With this approach, the main objective is determined and then the values related to this main objective are identified and iteratively decomposed until evaluation measures can be developed. The focus is on values first and alternatives second. However, in some cases,

the alternatives may be better known and a bottom-up approach may be the best way to develop the value hierarchy (Kirkwood, 1997). Using this approach, the alternatives are evaluated against each other to determine their differences and evaluation measures are developed to measure these differences. The measures are then grouped into values and the values are grouped to form layers within the hierarchy until the final objective is reached.

Another method of generating values is called the “gold standard” and consists of a review of relevant literature (Weir, 2003; Kirkwood, 1997). With this method, the analyst uses documents such as the strategic objectives, vision, and plan of an organization; regulations; laws; etc., to generate values for the decision maker’s consideration. By basing values on published source documents, the analyst is able to develop a hierarchy that is much more defensible to scrutiny from either the decision maker or people outside of the decision process. Developing a “strawman” hierarchy with the gold standard also allows the analyst to facilitate and guide the rest of the hierarchy construction process; the “strawman” serves to generate a higher level of efficiency by providing an initial starting point that can be reviewed and changed by the decision maker to more accurately reflect his or her personal hierarchy (Katzer, 2002).

The “silver standard,” or casual empiricism, is another method for developing values (Weir, 2003; Kirkwood, 1997). The silver standard involves sessions with the relevant stakeholders that are often conducted in large groups. There may only be a small number of people directly interested in a problem, but there are often other people who have valuable experience or information pertaining to the problem; consulting these people can help the analyst ensure that all relevant details are included (Kirkwood, 1997).

This method often produces a simpler, more logical structure than the gold standard that is more easily understood.

Yet another method of generating values is the “platinum standard” (Weir, 2003). Although the platinum standard focuses on interviews with key leadership and technical personnel involved in the decision, it is best to start with vision statements, strategic objectives, and other “doctrinal publications” as discussed in the gold standard. The platinum standard can actually be regarded as an extension or improvement of the gold standard. This method will usually produce the most insightful, simple, and logical structure for the value hierarchy.

Once the values relevant to the decision being made are generated, they are arranged in a tree-like structure with the fundamental objective at the top. Beneath the fundamental objective, the tiers of the hierarchy branch out to represent the full spectrum of values. Tiers are groupings of values that have the same level of importance in the value hierarchy. Depending on how complex the decision and value set associated with it are, there can be any number of tiers in a value hierarchy.

In order to help visualize what a value hierarchy looks like, consider the example of a person shopping for a new truck (Figure 3). The fundamental objective for this person is to buy the best truck. The first tier of values (cost, performance, and appearance) represent the values the decision maker (shopper) considers the most important in the decision. The decision maker has further decomposed performance into a second tier of values (power and off-road capability).

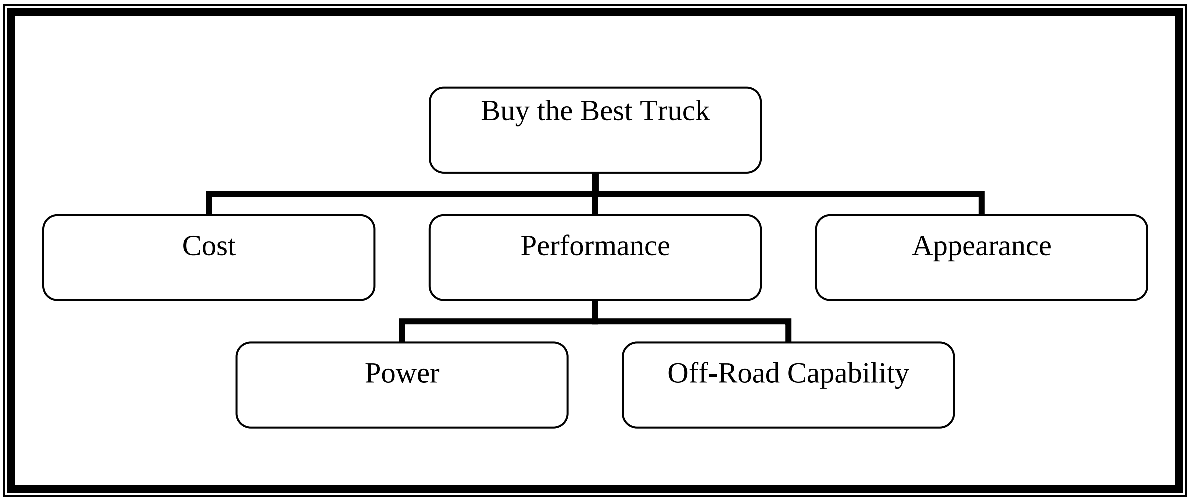


Figure 3. Example Value Hierarchy

There are several desired properties for a value hierarchy: completeness, nonredundancy, independence, operability, and "small" size (Kirkwood, 1997). Completeness (i.e., collectively exhaustive) addresses whether or not the hierarchy includes all of the evaluation concerns that are important to the decision. Completeness also requires that the evaluation measures adequately and appropriately measure how well an alternative attains the objective associated with each measure. If the hierarchy is not complete, then it can obviously lead to false insight based on the missing information.

Nonredundancy (i.e., mutually exclusive) simply means that a particular value is not covered more than once within the hierarchy. In other words, no values in the hierarchy overlap (Kirkwood, 1997). Nonredundancy prevents the values within the hierarchy from being given more weight (i.e., importance) than the decision maker intends. Similar to non-completeness, redundant values can contribute to false insight being gained from the hierarchy.

Independence (i.e., decomposability) means that the score of one measure within the hierarchy does not affect the score of any other measure. For instance, in the truck buying example, suppose the measure for power was horsepower and the measure for off-road capability was acceleration. These two measures would not be independent since a higher score for horsepower would always result in a higher score for acceleration (all other things remaining equal). Therefore, the score for acceleration is dependent on the score for horsepower.

Operability deals with whether or not the people using the model understand it (Kirkwood, 1997). Although the hierarchy must be technically accurate and complete, it must also be understandable by the target audiences. This sometimes requires compromises on some of the other characteristics of the hierarchy (Kirkwood, 1997). This is especially important if the decision is very complex but not all of the target audience is an expert or specialist in the area of study.

Finally, small size addresses the issue of how the size of the hierarchy affects the ability to explain, understand, and use the model. All things remaining equal, a smaller hierarchy can be communicated more easily and require fewer resources for evaluation purposes (Kirkwood, 1997). Unfortunately, the tendency for complex projects is to add values and measures to try and capture every possible variable. Consequently, the model becomes so large and cumbersome that understanding it or evaluating alternatives against it is technically or monetarily infeasible. Kirkwood (1997) argues that the quest for completeness and detail must be balanced against a realistic time frame and budget.

2.9.3.3 Step 3 – Evaluation Measure Development

In order to evaluate alternatives with a value hierarchy, it is necessary to create evaluation measures which assess the degree of attainment for the values. These measures allow alternatives to receive an objective and unambiguous rating with respect to each value (Kirkwood, 1997). As seen in Figure 4, it is possible for a value to have more than one measure associated with it in order to accurately capture how each alternative impacts that particular value. For instance, off-road capability could have multiple evaluation measures: four-wheel drive, tire size, and suspension rating. These multiple measures would give a more complete picture of an alternative's contributions towards off-road capability.

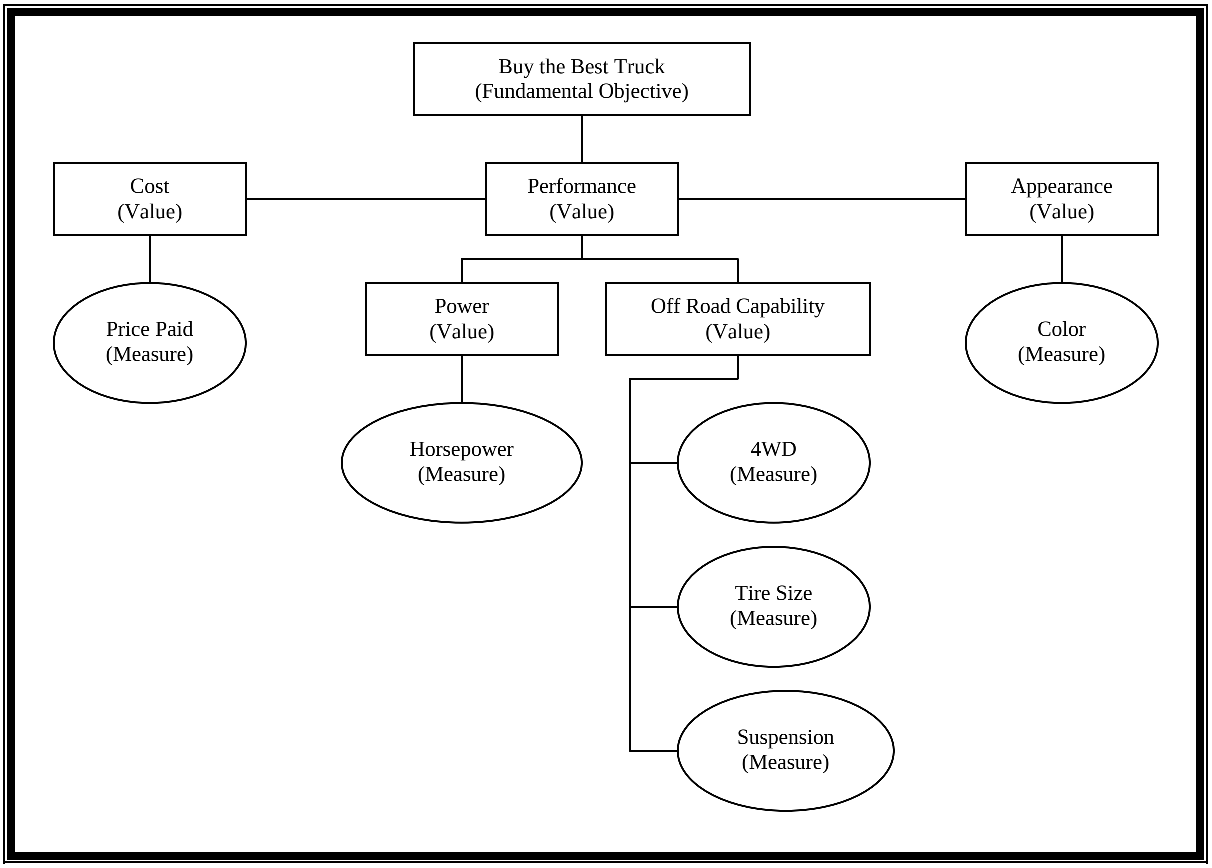


Figure 4. Example Value Hierarchy with Measures

Evaluation measures can be classified into differing types of scales. These scales are commonly classified as natural or constructed and direct or proxy (Kirkwood, 1997). A natural scale is one that is in general use and has a common interpretation by all users (Weir, 2003). An example of a measure with a natural scale is the price paid measure under the cost value in Figure 4. A constructed scale is used when no natural scale is available and is developed for use in a specific decision problem to measure the degree of attainment for a particular objective (Kirkwood, 1997). Constructed scales are often categorical in nature and define a finite number of levels of attainment. An example of a

constructed scale in the truck buying hierarchy is the suspension measure under the off-road capability value where the categories are standard, off-road, and towing. The score given to an alternative could differ from decision maker to decision maker, so each category has to be defined in detail (constructed) to eliminate bias and confusion during the scoring of alternatives.

The scales are also classified as either a direct or proxy scale. Direct scales focus on attainment of the objective itself and directly measure the level of attainment (Kirkwood, 1997). The most commonly used direct scale (for Americans) is dollars ($) to reflect the measure of cost. Proxy scales focus on the direct measurement of an associated objective, which is selected such that it will accurately reflect attainment of the primary objective (Kirkwood, 1997). An example of a proxy scale is the use of the Gross National Product (GNP) to reflect a measure of a nation's economic well being (Weir, 2003).

When deciding which evaluation measures and associated scales to use, the order of preference, as shown in Table 9, is typically natural direct, constructed direct, natural proxy, and finally constructed proxy. However, several other things need to be kept in mind when determining scales. Natural scales do not require as much development time and are less controversial because they are in general use (Kirkwood, 1997). However, there are a finite number of natural scales and the data to be measured against a natural scale is not always available. The relative importance of the objective being measured must be taken into account also (Kirkwood, 1997). Using a constructed scale that combines several natural scales may more accurately reflect the value of a particular objective instead of several measures with natural scales for each one. The type of

audience reviewing the results also figures into measure development (Kirkwood, 1997). Since the measures and scales need to be meaningful to the decision maker, a less technical audience may require measures that are also less technical and more operable in nature. Finally, measures must be able to pass the clairvoyance test (Kirkwood, 1997). Kirkwood (1997) asks, "If a clairvoyant were available who could foresee the future with no uncertainty, would this clairvoyant be able to unambiguously assign a score to the outcome from each alternative?"

Table 9. Preferred Order of Use for Evaluation Measure Scales
(Weir, 2003)

	Natural	Constructed
Direct	1	2
Proxy	3	4

2.9.3.4 Step 4 – Value Function Creation

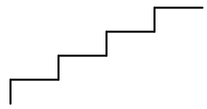
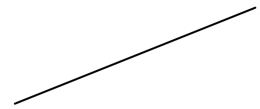
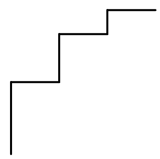
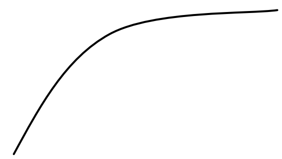
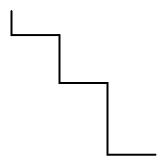
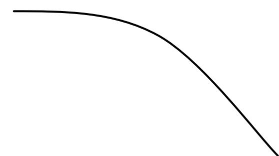
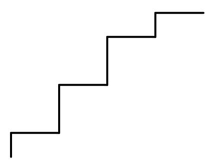
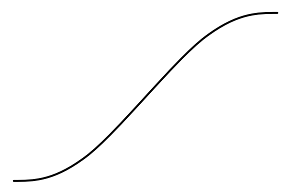
To use the VFT process, it is necessary to define Single Dimensional Value Functions (SDVFs) to allow the scales defined for the evaluation measures to be converted to a common scale so that scores can be combined, compared, and analyzed. A common scale is a necessity because of the multiple evaluation measures and thus multiple evaluation units that exist within the model. Therefore, SDVFs convert the individual units of each measure into "value" units that most often range from zero (lowest attainment) to one (highest attainment). In other words, the least preferred score for a particular measure would earn a "value" of zero while the most preferred score

would earn a “value” of one (Kirkwood, 1997). The main purpose of this step is to convert subjective decisions into scores that can be examined objectively by the decision maker.

Each individual SDVF is defined by its shape, which is determined by soliciting input from the decision maker or subject matter experts (SMEs) to determine how the evaluation measure scores should be converted into “value” units. There is one major restriction on the shape of the SDVF. It must be monotonic in nature, which means that the slope of the SDVF is either positive or negative across the entire range of the function; it cannot be positive and negative within the same function. In other words, an increasing function indicates that the higher levels of the evaluation measure are always preferred over the lower levels. Similarly, a decreasing function indicates that the lower levels of an evaluation measure are always preferred over the higher levels.

The shape of each SDVF is determined by the returns to scale associated with the respective evaluation measure. Returns to scale can be broken down into four categories: constant, increasing, decreasing, or a combination of the above. Kirkwood (1997) states there are two possible shapes to reflect these returns to scale: piecewise linear and exponential. These shapes are all represented in Table 10. Piecewise linear functions are typically used when there are a finite number of scoring levels for the measure, such as with a categorical measure (Kirkwood, 1997). Exponential functions, on the other hand, are used when a measure has an infinite number of scoring levels. For the truck buying example, Figures 5 and 6 show a monotonically increasing piecewise linear function and a monotonically decreasing exponential function for the color and cost evaluation measures, respectively.

Table 10. Common SDVF Shapes

	Piecewise Linear	Exponential
Constant		
Increasing		
Decreasing		
Other		

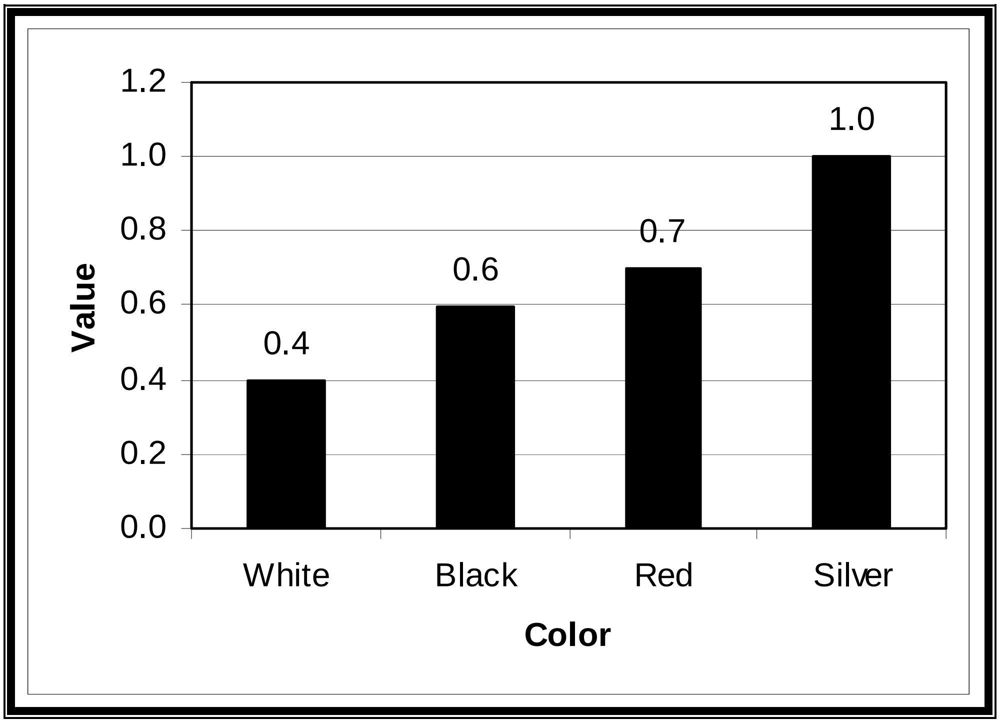


Figure 5. Monotonically Increasing Piecewise Linear SDVF

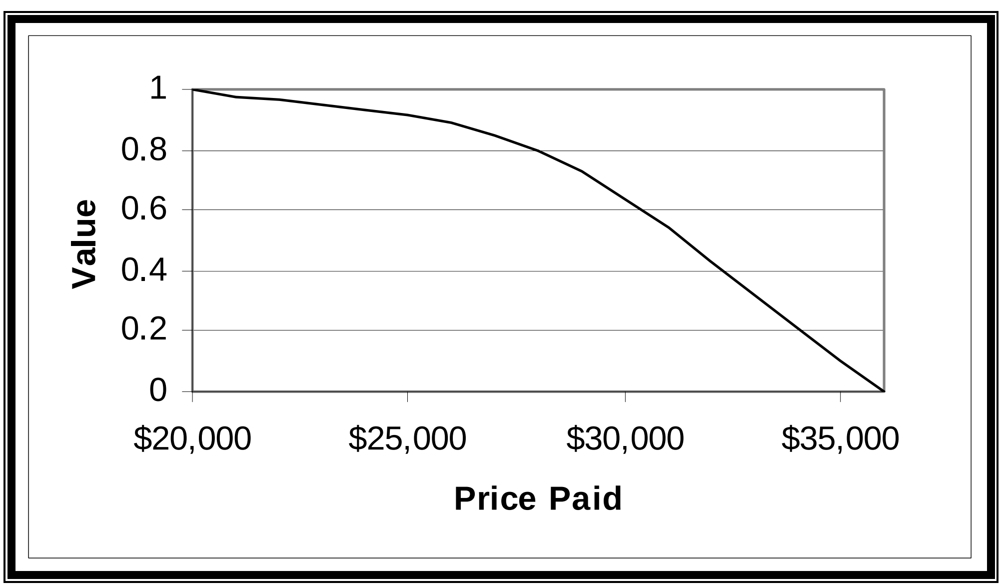


Figure 6. Monotonically Decreasing Exponential SDVF

2.9.3.5 Step 5 – Value Hierarchy Weighting

After the values of the decision maker are clearly identified, and the related evaluation measures are created, it is important to determine the relative importance of the values and measures. Weighting the value hierarchy allows the PDM (or proxy) to truly define his or her values by indicating which values are of the highest importance. Weights can be assigned locally or globally depending on which method the analyst feels better represents the decision maker's value ranking.

2.9.3.5.1 Local Weighting

Local weighting refers to the relative importance assigned to values or measures that are located on the same tier and within the same branch of the hierarchy (Weir, 2003). The sum of the local weights (same tier of any given branch) must sum to one as seen in Figure 7. Local weighting is usually, but not always, accomplished with a top-down approach typically using either the direct weighting or swing weighting technique. The direct weighting method is often referred to as the 100-marble weighting system. With this method, the PDM is given 100 imaginary marbles and asked to apportion the marbles in imaginary boxes to signify the importance of the values (or measures) on the same tier within a branch of the hierarchy. The number of marbles in each box (divided by 100) thus represents the PDM's importance ranking for each value (or measure). This technique gives the decision maker a much more direct, visual, and clear understanding of the importance each weight represents.

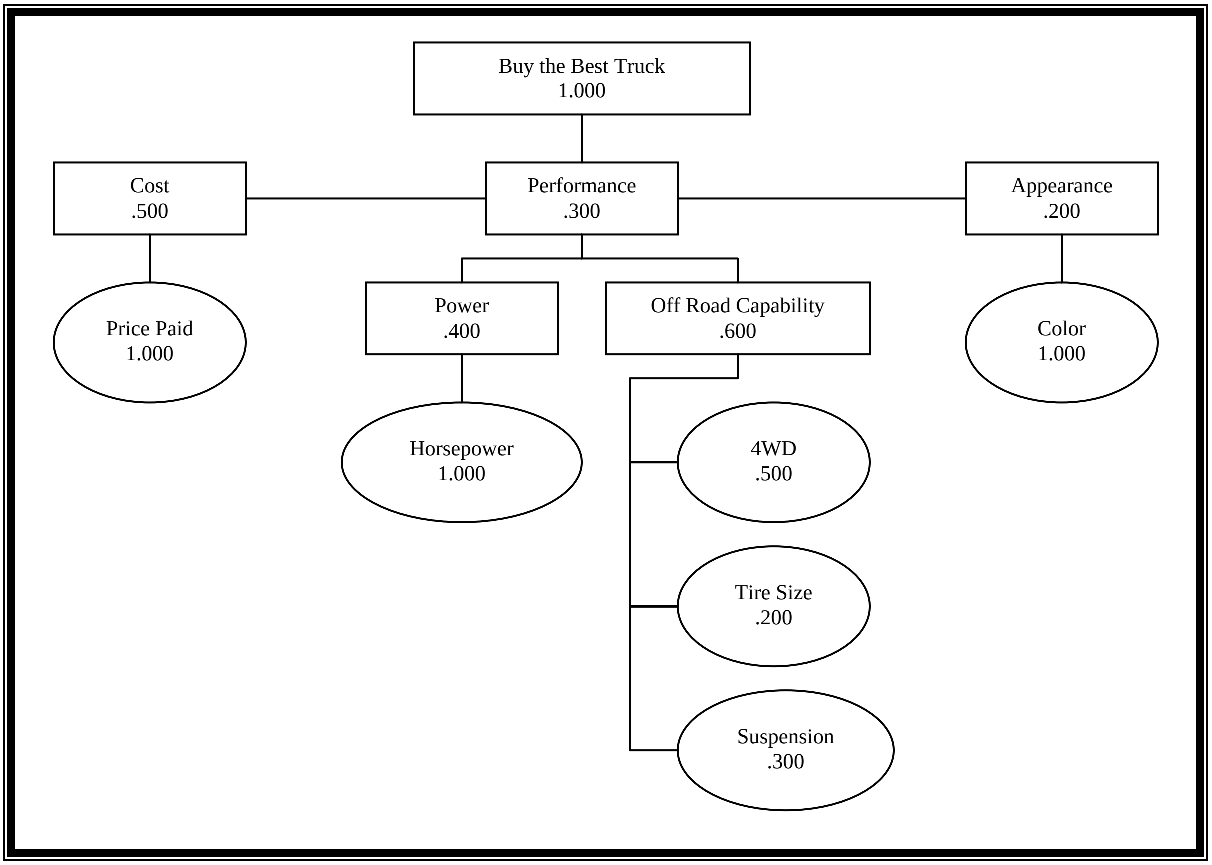


Figure 7. Example Hierarchy with Local Weights

Swing weighting can actually be accomplished with two slightly different techniques. The first requires that the decision maker evaluate the value increments associated with "swinging" from the least preferred scenario to the most preferred scenario of each evaluation measure (Kirkwood, 1997). The value increments are then scaled as multiples of the smallest value increment. The second technique is very similar but begins with the decision maker making a subjective determination as to which measure within that tier of the branch is least important. Once that is determined, the decision maker subjectively determines the importance of the other measures in multiples of the least important one. With both techniques, the importance ratings are combined

algebraically in a summation equation equal to one (since the weights within a tier of the same branch must equal one). The equation is then solved to determine the weight for the evaluation measure with the smallest value increment (or least importance). The weights for the remaining values (or measures) are determined from the previous mathematical relationship (i.e., the summation equation).

2.9.3.5.2 Global Weighting

Global weighting, often called overall weighting, refers to the relative importance assigned to values or measures across an entire tier; it shows how each individual value or measure contributes to the overall objective (Katzer, 2002). Although the same techniques that are used for local weighting can be applied to global weighting, the most common practice is to assign local weights and then work mathematically through the hierarchy to determine the related global weights. Global weights are often used as a "double check" to ensure the PDM understands how the local weights are affecting the overall model. To calculate global weights in a top-down manner, simply multiply the local weights of each value or measure by the local weight of every value above it. For example, to find the global weight of power in the truck buying example, its local weight of 0.400 would be multiplied by the local weight of performance (0.300) and the local weight of the fundamental objective (1.000). This would result in a global weight of 0.120. Since the local weight of the horsepower measure is 1.000, its global weight is also 0.120. This is illustrated in Figure 8.

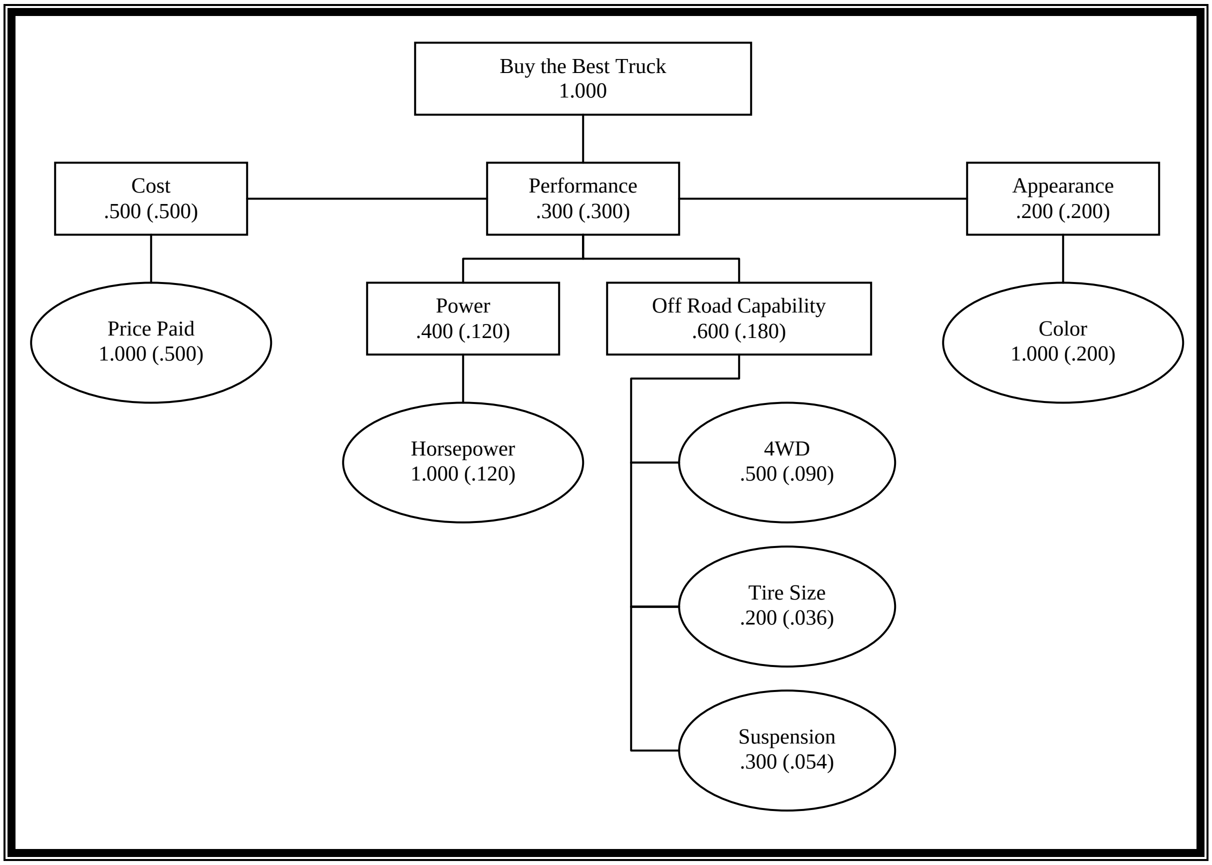


Figure 8. Example Hierarchy with Global Weights
(Global Weights in Parentheses)

2.9.3.6 Step 6 – Alternative Generation

Once the hierarchy has been fully developed, the next step is to generate alternatives. The process of creating the hierarchical model can be very beneficial to the decision maker at this point; the accomplishment of the previous steps helps foster understanding of the problem, insight, and creativity, all of which can aid in development of new and better alternatives. Previous experiences can also be used to develop alternatives in a process called associative reasoning, which is simply associating the current situation with relevant past ones and using those past experiences to develop thoughts and ideas (Kirkwood, 1997). If alternatives are difficult to develop, a good tool

to use is a strategy table (Kirkwood, 1997; Weir, 2003). These are tables that outline pieces of alternatives, measures, and other parts of the puzzle that allow a user to visualize new strategies suitable to the problem. Another technique that can be used is to identify value gaps in the current alternatives (Weir, 2003). If the alternatives, or even just the top alternative, could improve its rating by improving in a particular area, then there is a value gap in that area. A new alternative or modification to the present alternative can then be explored to exploit the value gap. If there are too many alternatives to choose from, screening criteria can be used to reduce the number of alternatives considered to a more feasible level. Mathematical optimization can also be used and is most frequently accomplished with linear integer programming (Kirkwood, 1997).

2.9.3.7 Step 7 – Alternative Scoring

Once the alternatives have been generated, the next step is to score them. Although this step appears relatively straightforward, it can be one of the most difficult to accomplish if the model has been poorly developed. This is where creating a hierarchy that fits the completeness, nonredundancy, independence, operability, and "small" size criteria can pay big dividends. Collecting the data to score the alternatives can be an immensely difficult and time consuming process if the value hierarchy has numerous measures, measures with difficult to obtain data, or measures with ambiguous scoring criteria. Therefore, following a few simple rules can help smooth this step and ensure proper scoring. First, always properly document where scoring data was obtained so that the scoring can be repeated or tested. Second, the data should also be scored blindly without knowing how each score affects the "value" units earned. Finally, it is extremely

helpful to score one measure at a time across all the alternatives; this will help eliminate bias by maintaining consistent application of the evaluation criteria.

2.9.3.8 Step 8 – Deterministic Analysis

Deterministic analysis requires the use of an equation that combines the value "points" for each alternative (translated from the scoring data by the SDVFs) with the weights determined by the decision maker. The "value" points and weights are paired to give an aggregate score for each alternative that can be used for a deterministic (rack and stack) analysis of the alternatives. The VFT process typically uses an additive value function (summation) to determine the aggregate score. The required conditions for using an additive value function are a valid SVDF associated with each measure, a weight assigned to each measure, and a summation of weights that equals one. When these conditions are met, the additive value function can be represented as:

$$v(x) = \sum_{i=1}^{n} \lambda_i \cdot v_i(x_i)$$

where $v(x)$ is the value function (i.e., aggregate score), $v_i(x)_i$ is the individual measure value converted from the scoring data by the SDVF, and λ_i is the global weight for each respective measure (Kirkwood, 1997).

2.9.3.9 Step 9 – Conduct Sensitivity Analysis

When the initial ranking of the alternatives is completed by the deterministic analysis, additional insight is available to the decision maker through the use of sensitivity analysis. This is one of the great advantages of using a model; it allows the analyst to determine how changes in model assumptions impact the deterministic analysis of the alternatives (Kirkwood, 1997). One of the most common applications of

sensitivity analysis is to look at how changes to the assigned weights affect the results. Since the weights reflect the relative importance of the values in the hierarchy, it is often useful to show the decision maker how the use of different weighting schemes might affect the ranking of the alternatives. In addition to providing for a more informed decision, this might also indicate the need for extra research in a particular area or the deletion of non-sensitive values from the hierarchy. The most common method of sensitivity analysis is varying the weight of one value while holding the weights of all other values proportionally constant and ensuring the weights sum to one. Sensitivity analysis might also involve changing the weights on one tier of a branch as a group while still ensuring the weights in that tier sum to one. More involved types of sensitivity analysis also exist but are outside the scope of this research.

2.9.3.10 Step 10 – Presentation of Results

After the analysis has been completed, the results are presented to the decision maker by the analyst in a clear, understandable manner. The analysis should be tailored to the questions initially asked (i.e., fundamental objective) and the insights the decision maker is attempting to gain. At this stage, it is imperative for the analyst and decision maker to remember that the VFT process is designed only to provide insight and clarity about the decision; it is not designed to make the decision itself. The final decision should always be at the discretion of the decision maker regardless of the results of the analysis.

Chapter 3. Methodology

The United States Air Force has been directed by the Secretary of Defense to privatize all available utility systems. To accomplish this objective in the most efficient and effective manner, it is necessary to develop a source selection process that is objective, repeatable, and defendable. The value focused thinking (VFT) methodology provides a process to determine the values and measures of the Air Force regarding utilities privatization and is very applicable because of the number of subjective factors that need to be quantified in order to develop an objective view of the source selection decision. The VFT methodology also allows weights of importance to be assigned to each value and measure, thereby allowing multiple competing values to be traded off against each other during the decision making process. This chapter examines how Steps 1 through 7 of the VFT process were applied in order to create a model that objectively quantifies the source selection decision.

3.1 Step 1: Problem Identification

The first step in the 10-Step Value Focused Thinking (VFT) methodology is to identify the problem in terms of an objective question. Discussions with the Air Force Civil Engineer Support Agency (AFCESA) revealed that gaps existed in the utilities privatization (UP) arena in determining a "methodology for awarding, implementing, measuring and verifying UP contractor performance in performance-based UP contracts (Stahl, 2003)." It was then concluded that VFT was an appropriate methodology to

develop a tool for analyzing contractor proposals during competitive utilities privatization solicitations.

In order to keep the scope of this thesis manageable, it was decided that the model would be designed specifically for analyzing the source selection decision for privatizing an electrical system. Therefore, the identified problem in the form of a general objective question became: "Do we award the electrical system at Air Force Base X to Contractor A, B, or C?" This objective question, used to guide the process of building the model, incorporated the specific contractors being evaluated and the specific base where the privatization effort was underway.

3.2 Step 2: Create the Value Hierarchy

With the problem clearly identified, the next step was to solicit the values relating to the fundamental objective and logically group them into a hierarchy. Therefore the analyst created an affinity diagram of values obtained from literature and based on experience that may influence a utilities privatization source selection decision. As shown in Figure 9, four top values emerged from the affinity grouping process: Cost, Responsiveness, Reliability, and Quality. Responsiveness and Reliability were then grouped under the single value of Mission Capability, leaving the hierarchy with three values on the first tier: Cost, Mission Capability, and Quality.

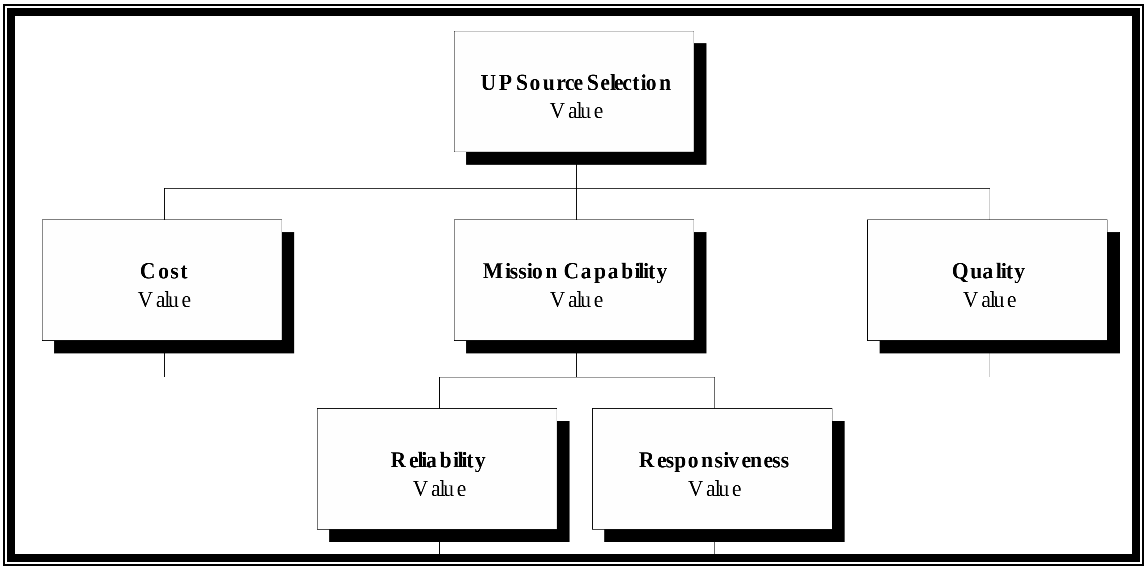


Figure 9. Initial Tiers of Strawman Hierarchy

To decompose the values, the most recent revision to the Request for Proposal (RFP) template (February of 2003) was analyzed. Every statement that reflected a potential desired value was recorded; the resulting values that were integrated into the model are listed in Table 11. This list confirmed that the first-tier values developed from the affinity diagram (Cost, Mission Capability, and Quality) were still applicable and accurate representatives for the model. Subsequently, the remainder of the value hierarchy was generated from the values identified during the affinity grouping process and the RFP review. The resulting "strawman" hierarchy, developed using the gold standard, is shown in Figures 10, 11, 12, and 13.

Table 11. Potential Values Gleaned from RFP Template

- Purchase Price
- Recoverable Portion of the Purchase Price
- # of Months Credit will be Realized
- % Points Above or Below U.S. Treasury Bond Rate
- Transition Period Cost
- # of Transition Days
- Fixed Monthly Charge
- Tariff Rate
- Initial Capital Upgrades
- Capital Investments (Upgrades and Renewals)
- Licenses, Permits, or Certifications
- Compliance with Federal, State, Interstate, and Local Laws
- Quality Management Plan
- Submetering (Installation, Maintenance, Reading, Calibration, and Reporting)
- Commodity Management
- Energy and Water Conservation
- Energy and Water Saving Projects (Current and Future)
- Efficiency Upgrades Proposed
- Maintain Record Drawings of Facilities
- Employees Not a Potential Threat
- Employees Understand, Read, Write, and Speak English
- Employees Meet Applicable Federal, State, Local, and Installation Certification, Licensing, and Medical Requirements
- Employees Cannot Generate Conflicts of Interest
- Military Employees Cannot Constitute Excuse for Nonperformance
- National Agency Check Information
- Emergency Restoration Plan Adhered To
- Service Interruption/Contingency Plan
- Credit to AF for not Meeting Restoration Times (N/A for Regulated Utility)
- Service Request System
- Emergency, Urgent, and Routine Service Responses
- Work Coordination and Notification
- Service Record Retainage
- Exercises/Contingencies
- Excavation Permit Process
- Attendance of Contracting Meetings
- Environmental Permits and Compliance
- Spill Contingency Plan
- HazMat and HazWaste Minimization Plan

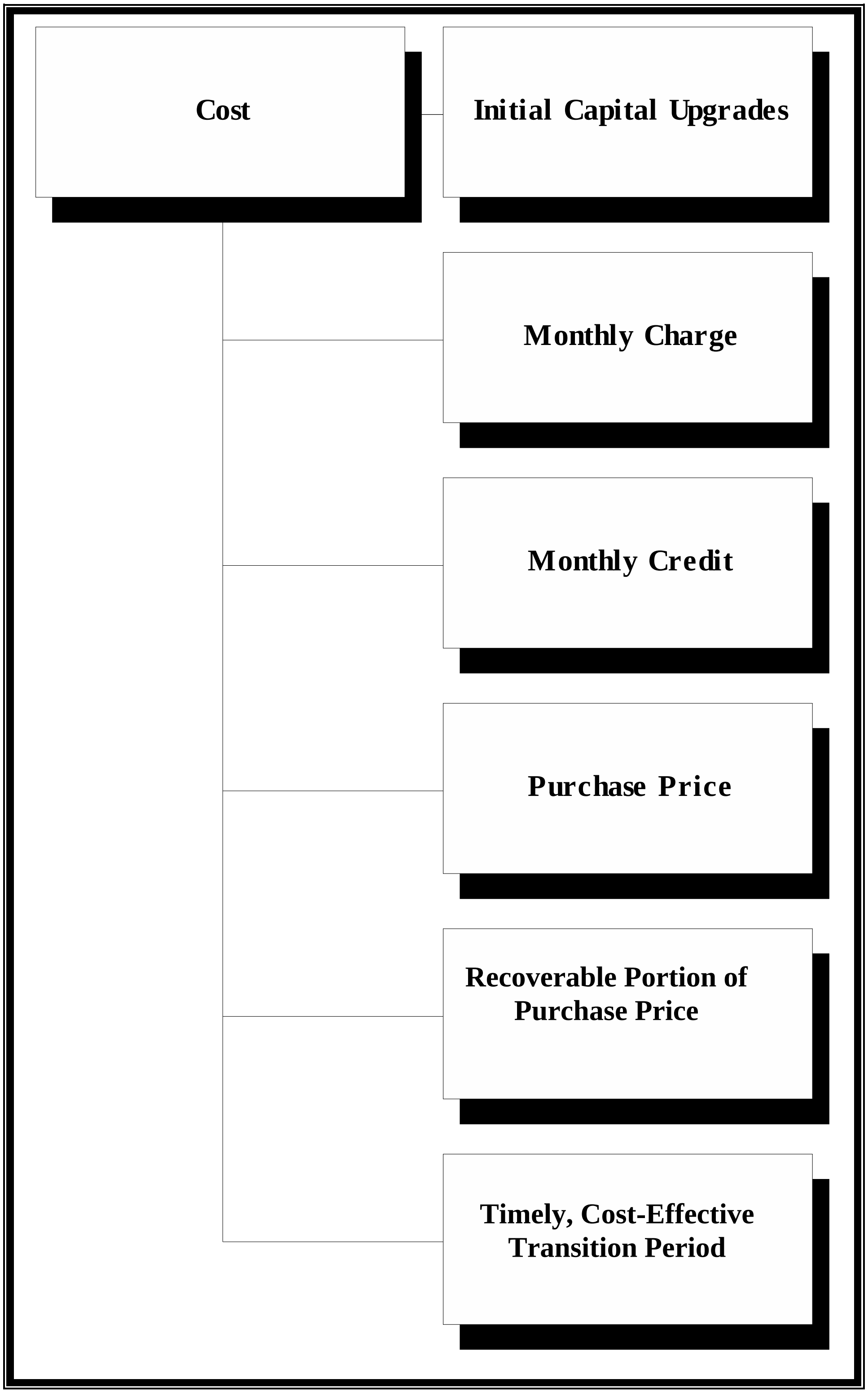


Figure 10. Cost Branch of Strawman Hierarchy

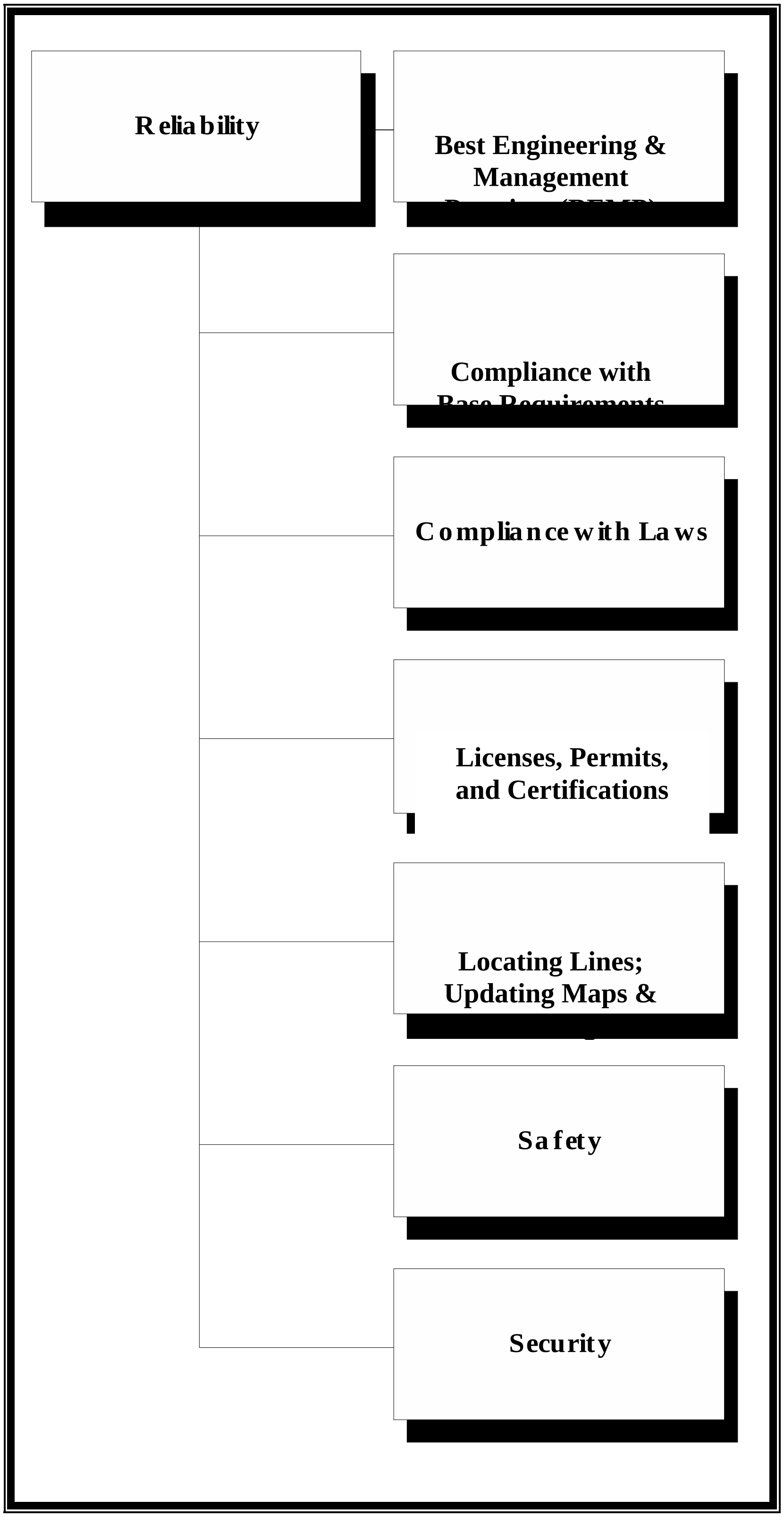


Figure 11. Reliability Branch of Strawman Hierarchy

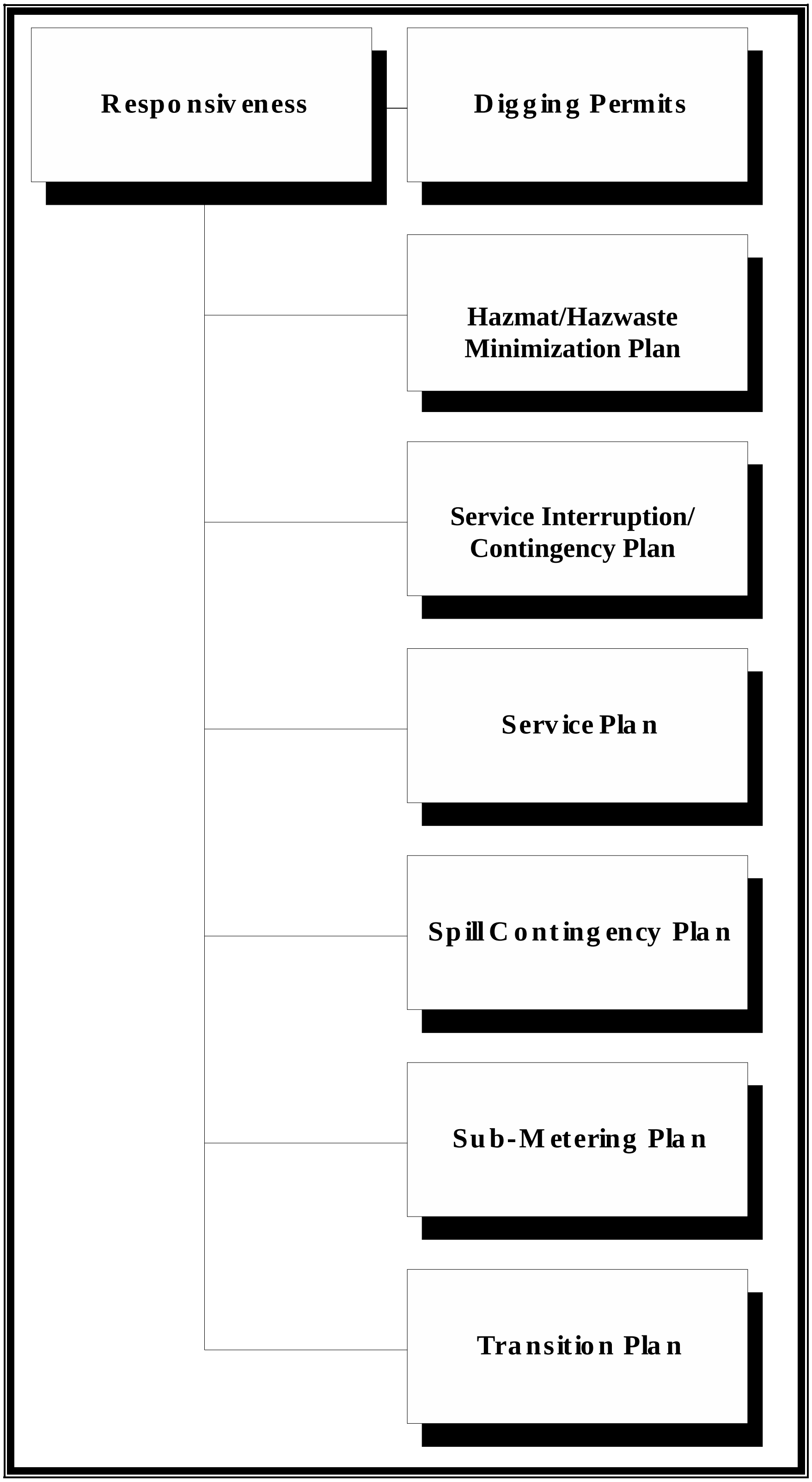


Figure 12. Responsiveness Branch of Strawman Hierarchy

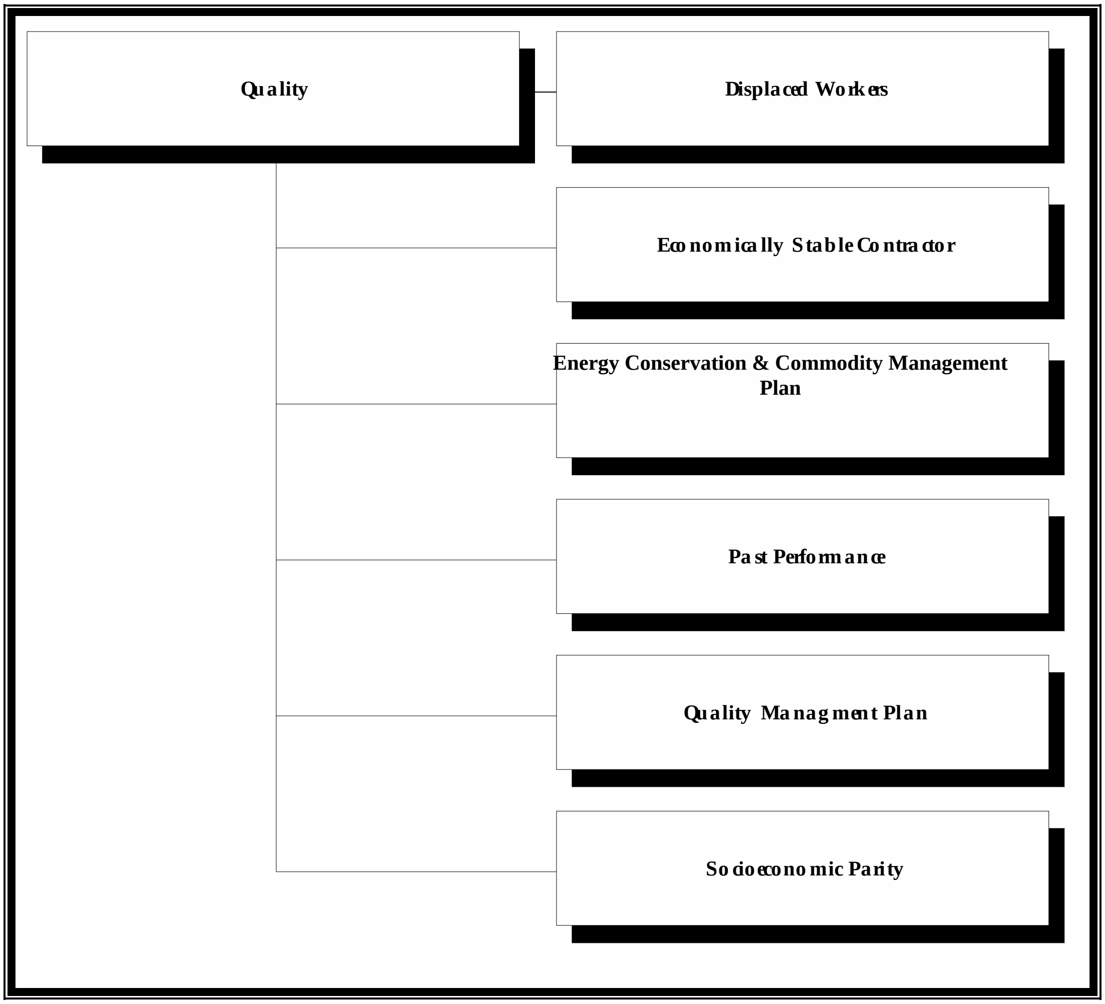


Figure 13. Quality Branch of Strawman Hierarchy

The “strawman” hierarchy was used to facilitate discussions with the PDM, who was an AFCESA representative experienced in evaluating source selection proposals. Over a span of several months, the analyst worked with the PDM to develop a new hierarchy that the PDM thought better reflected the Air Force’s values regarding utilities privatization source selection. The top three values (i.e., first-tier) in the hierarchy, which represent the most important aspects of the fundamental objective, were identified by the PDM as: Capability/Risk, Cost, and Past Performance. The final hierarchy, developed using the platinum standard and consisting of 16 values and 26 measures, is shown in Figure 14.

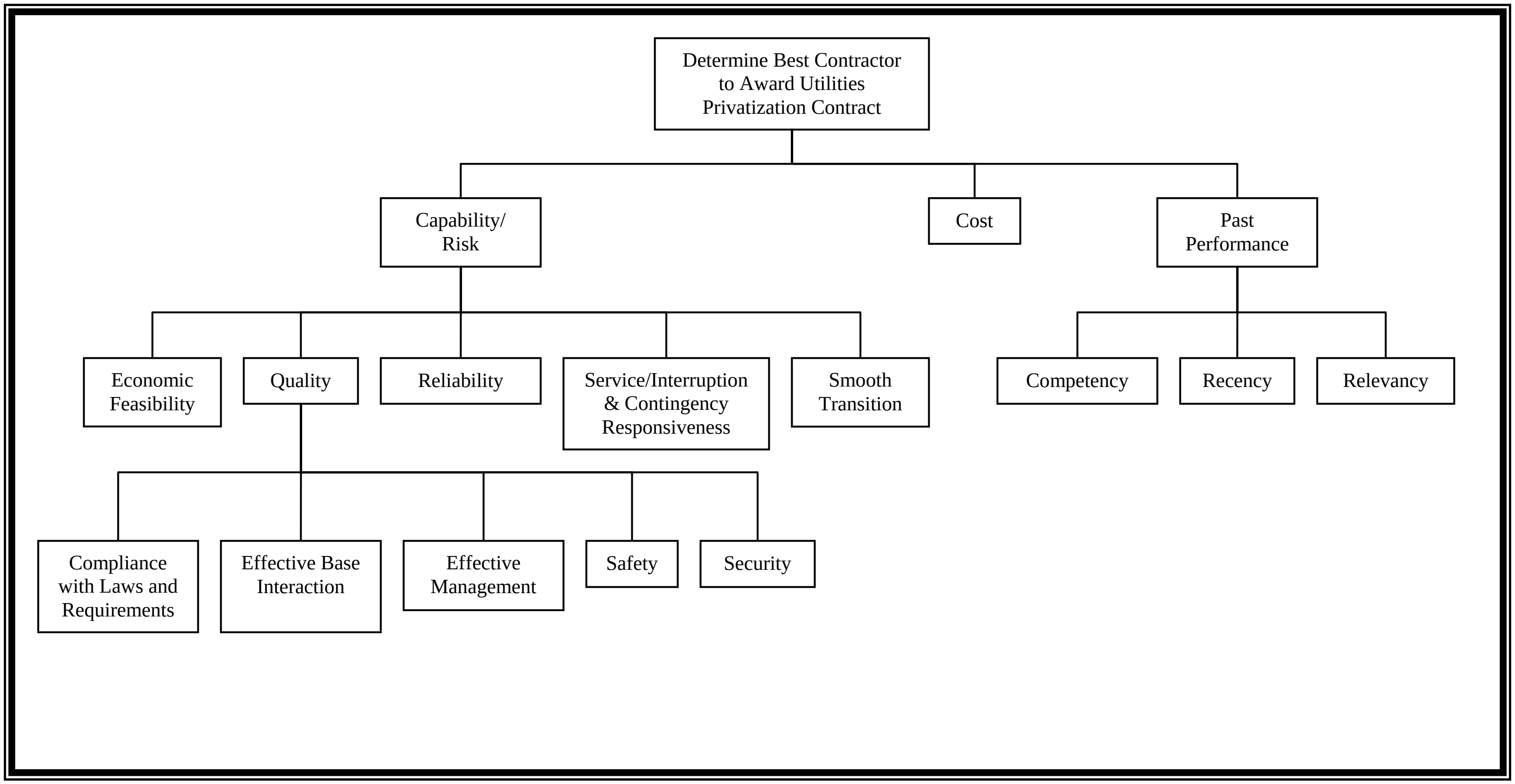


Figure 14. Final Value Hierarchy

The Capability/Risk value is concerned with the overall capability of and the feasibility of the plans, work, and costs outlined in the proposal. This is extremely important to the Air Force since one of the core reasons behind privatization is to increase the quality and efficiency of the service being provided. The Cost value is focused on the net present value (NPV) of the expected stream of cash flows over the lifetime of the contract. Once again, cost savings is associated with the utilization of a private firm's greater expertise and efficiency and is one of the top reasons given for privatizing a system. Past Performance is also a highly desirable value since it is an indicator of the Air Force's confidence in the contractor's ability to perform as promised. This confidence level is very important due to the length of most utilities privatization contracts. The lower tier values identified for each of these top tier values adds specificity in terms of what the Air Force deems important in evaluating contractor proposals in a utilities privatization source selection scenario. Explanations of all values within the hierarchy are presented in Appendix A.

3.3 Step 3: Develop Evaluation Measures

After the value hierarchy was created, the next step was to create and define evaluation measures that allow for the measurement of the attainment of the objectives and values. The measures provided the ability to quantify various aspects of the hierarchy and allowed for a more objective decision making process. To make the hierarchy operable and complete while preserving independence and nonredundancy among the evaluation considerations, the evaluation measures were also generated using the RFP template and PDM inputs to determine what data could be gleaned from

proposals if submitted correctly and completely. At the same time, every effort was made to keep the hierarchy as small as possible to maintain its ease of use.

In creating the measures used in this model, the intention was to have as many measures with natural, direct scales as possible and as few measures with constructed, proxy scales as possible. This was a very difficult proposition, however, since proposals typically do not have historical or hard data for most of the measures. This meant that a great deal of categorical measures with constructed, proxy scales had to be used (3 Natural, Direct; 4 Natural, Proxy; 19 Constructed, Proxy). Table 12 summarizes the evaluation measures that were developed in the model. To develop the scales for each measure, the PDM decided whether categorical or quantitative scales were appropriate and defined the upper and lower bounds for each of the measures. The definitions for each measure are listed in Appendix B. As an example, the definitions used for “Interest Coverage” and “Compliance with Federal, Interstate, State, and Local Laws” are shown in Tables 13 and 14 respectively.

Table 12. Evaluation Measures Summary

First Tier Value	Second Tier Value	Third Tier Value	Measure	Lower Bound	Upper Bound
Capability/ Feasibility	Economic Feasibility	N/A	Interest Coverage	Unqualified	Unconditionally Qualified
			FFO to Interest Ratio	Unqualified	Unconditionally Qualified
			FFO to Total Debt Percentage	Unqualified	Unconditionally Qualified
			Total Debt to Total Capital Ratio	Unqualified	Unconditionally Qualified
			Disaster Recovery Ratio	Unqualified	Unconditionally Qualified
	Quality	Compliance with Laws and Requirements	Compliance w/Fed., State, Interstate, & Local Laws Adequately	None	Exceptional
			Compliance with Base Requirements Adequately Adressed	None	Exceptional
			Licensing, Permitting, & Certification Adequately Addressed	None	Exceptional
		Effective Base Interaction	Line Locating; Updating Maps & Drawings Adequately Addressed	None	Exceptional
		Effective Management	Best Engr & Mgmt Practices Adequately Addressed	None	Exceptional
			Level of Awards and Certificates	None	National
		Safety	Certification of Employees Adequately Addressed	No	Yes
			English Skills of Employees Adequately Addressed	No	Yes
		Security	NAC Information Gathering/Providing Adequately	No	Yes
	Reliability	N/A	Capital Upgrades & Renewals and Replacements Plan Adequacy	None	Exceptional
	Service/ Interruption & Contingency Responsiveness	N/A	Hazmat/Hazwaste Minimization Adequately Addressed	None	Exceptional
			Service Providance Adequately	None	Exceptional
			Spill Contingency Plan Adequacy	None	Exceptional
	Smooth Transition	N/A	Days to Transition	90	365
			Transition Plan Adequacy	None	Exceptional
Cost	N/A	N/A	CEA NPV % of Should Cost	100	75
Past Perfomance	Competency	N/A	% of Positive Past Performance	66	100
	Recency	N/A	# of Similar Scope Systems in Last	0	5
			# of Similar Scope Systems in Last	0	5
	Relevancy	N/A	% of Similar Scope Systems in Last	0	50
			% of Similar Scope Systems in Last	0	50

Table 13. Category Definitions for Interest Coverage Measure

Category	Category Definition
Unqualified	1.0 x or less for Investor Owned system. 1.0 x for less for Municipal or Cooperative Owned system.
Conditionally Qualified	1.0-2.5 x for Investor Owned system. 1.0-1.5 x for Municipal or Cooperative Owned system.
Unconditionally Qualified	2.5 x or greater for Investor Owned system. 1.5 x or greater for Municipal or Cooperative Owned system.

Table 14. Category Definitions for Compliance with Federal, Interstate, State, and Local Laws Measure

Category	Category Definition
None	Compliance with these laws is not addressed in the proposal.
Minimal	Proposal shall address all applicable federal, state, interstate, and local laws/regulations that must be complied with in order to provide this service including those requirements relating to health, safety, and the environment.
Good	Proposal expands to address specifically how each applicable law will affect each portion of the operation and how each facet will be managed to avoid non-compliance.
Exceptional	Proposal includes all previous and also addresses plan for modifying service practices as applicable laws are dropped, added, or amended. Should include discussion of pending laws and changes to laws.

3.4 Step 4: Create Value Functions

Once the measures for quantifying the lower tier values were determined, the next step was to define the single dimension value functions (SDVFs) for each of the measures. Since the x-axis bounds were identified in Step 3, each SDVF transforms the x-axis scores into y-axis "value" units. This quantifies the subjective pieces of the model, thereby allowing objective analysis to take place later in the process. As defined in Chapter 2, the value functions have "value" units that range from 0 to 1 with the least preferred category or score for that measure receiving a 0 and the most preferred category or score for that measure receiving a 1. The SDVFs were determined iteratively in two ways. Continuous functions were defined by using Excel macros to create visual functions within spreadsheets that could be adjusted by the PDM for inclusion in the model. Discrete functions were defined directly by the PDM. Examples of each are provided in the following figures.

Figure 15 shows the exponential, monotonically decreasing SDVF for the "CEA NPV % of Should Cost" measure and Figure 16 shows the discrete, monotonically increasing SDVF for the "Interest Coverage" measure. The SDVFs for all of the measures are included in Appendix B.

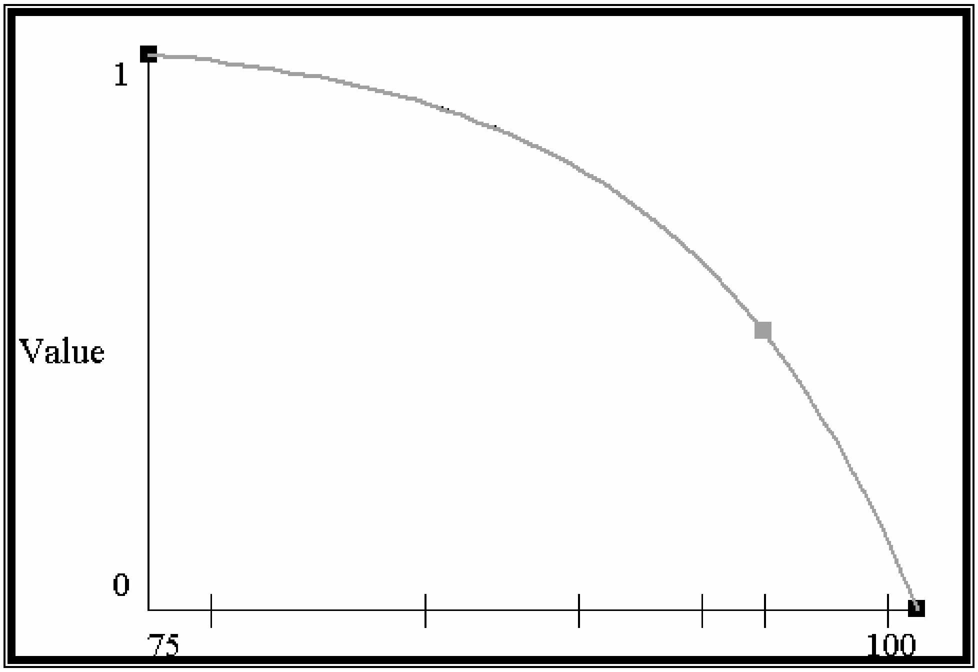


Figure 15. SDVF for CEA NPV % of Should Cost

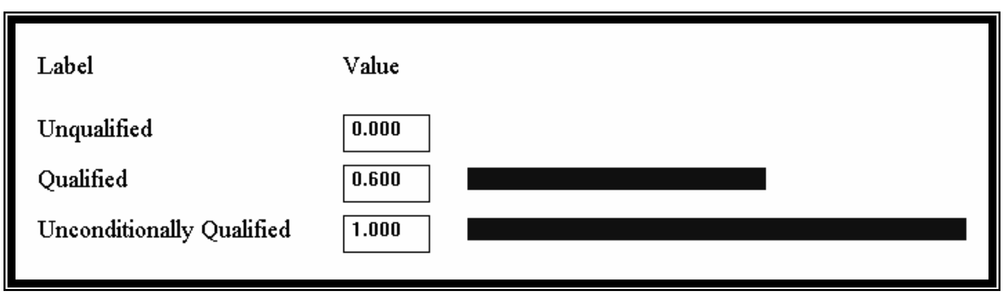


Figure 16. SDVF for Interest Coverage

3.5 Step 5: Weight the Value Hierarchy

Once the measures and SDVFs were determined, each of the values and measures were assigned a relative importance (or weight), thereby allowing the PDM to differentiate between the significance of each of the values represented in the hierarchy. At the request of the PDM, the local weights were initially solicited from a subject matter expert (SME) and then forwarded to the PDM for refinement. The SME weighted each component using a top-down approach and was instructed to do this by using the 100 marbles technique to facilitate the process. The weights returned by the PDM were then used to determine the global weights. The PDM reviewed the global weights to ensure a complete understanding of their global impact.

Figure 17 shows the complete hierarchy with the local and global weights (global weights in parentheses) for each value. Table 15 provides the local and global weights for each of the measures; Table 16 shows a cumulative look at the global weights by ranking the measures from highest global weight to lowest global weight. The three measures with the highest global weights are the “CEA NPV % of Should Cost” measure (0.250), the “Capital Upgrades and Renewals & Replacements Plan Adequacy” measure (0.125), and the “% of Positive Past Performance Reviews” measure (0.100). This makes intuitive sense because decreased cost and increased reliability are two of the major benefits of privatization, while past performance reviews are the most powerful indicator of future performance. These three measures comprise 47.5% of the total value represented in the model. Table 16 also shows that the top 17 measures hold approximately 90% of the global weight in the model.

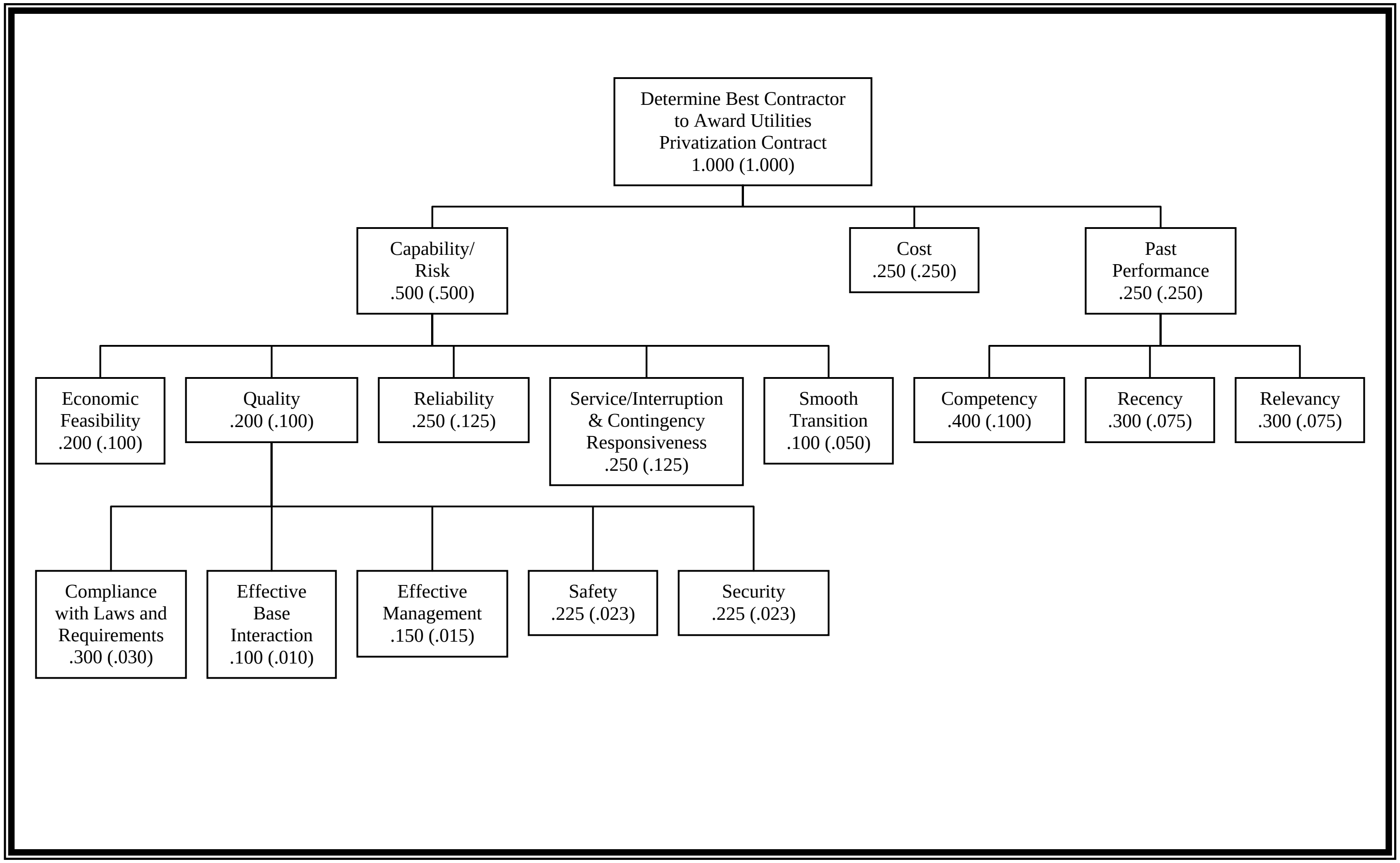


Figure 17. Value Hierarchy with Local and Global Weights (Global in Parentheses)

Table 15. Local and Global Weights of Evaluation Measures

First Tier Value	Second Tier Value	Third Tier Value	Measure	Local Weights	Global Weights
Capability/ Feasibility	Economic Feasibility	N/A	Interest Coverage	0.200	0.020
			FFO to Interest Ratio	0.200	0.020
			FFO to Total Debt Percentage	0.200	0.020
			Total Debt to Total Capital Ratio	0.200	0.020
			Disaster Recovery Ratio	0.200	0.020
	Quality	Compliance with Laws and Requirements	Compliance w/Fed., State, Interstate, & Local Laws Adequately Addressed	0.350	0.010
			Compliance with Base Requirements Adequately Adressed	0.300	0.009
			Licensing, Permitting, & Certification Adequately Addressed	0.350	0.010
		Effective Base	Line Locating; Updating Maps & Drawings Adequately Addressed	1.000	0.010
		Effective Management	Best Engr & Mgmt Practices Adequately Addressed	0.600	0.009
			Level of Awards and Certificates	0.400	0.006
		Safety	Certification of Employees Adequately Addressed	0.600	0.014
			English Skills of Employees Adequately Addressed	0.400	0.009
		Security	NAC Information Gathering/Providing Adequately Addressed	1.000	0.023
	Reliability	N/A	Capital Upgrades & Renewals and Replacements Plan Adequacy	1.000	0.125
	Service/ Interruption & Contingency Responsiveness	N/A	Hazmat/Hazwaste Minimization Adequately Addressed	0.300	0.038
			Service Providance Adequately Addressed	0.350	0.044
			Spill Contingency Plan Adequacy	0.350	0.044
	Smooth Transition	N/A	Days to Transition	0.400	0.020
			Transition Plan Adequacy	0.600	0.030
Cost	N/A	N/A	CEA NPV % of Should Cost	1.000	0.250
Past Perfomance	Competency	N/A	% of Positive Past Performance Reviews	1.000	0.100
	Recency	N/A	# of Similar Scope Systems in Last 1-3 Years	0.600	0.045
			# of Similar Scope Systems in Last 4-5 Years	0.400	0.030
	Relevancy	N/A	% of Similar Scope Systems in Last 1-3 Years	0.600	0.045
			% of Similar Scope Systems in Last 4-5 Years	0.400	0.030

Table 16. Cumulative Chart of Measure Global Weights

Measure	Local Weights	Global Weights	Cumulative Global Weight
CEA NPV % of Should Cost	1.000	0.250	0.250
Capital Upgrades & Renewals and Replacements Plan Adequacy	1.000	0.125	0.375
% of Positive Past Performance Reviews	1.000	0.100	0.475
# of Similar Scope Systems in Last 1-3 Years	0.600	0.045	0.520
% of Similar Scope Systems in Last 1-3 Years	0.600	0.045	0.565
Service Providance Adequately Addressed	0.350	0.044	0.609
Spill Contingency Plan Adequacy	0.350	0.044	0.653
Hazmat/Hazwaste Minimization Adequately	0.300	0.038	0.691
Transition Plan Adequacy	0.600	0.030	0.721
# of Similar Scope Systems in Last 4-5 Years	0.400	0.030	0.751
% of Similar Scope Systems in Last 4-5 Years	0.400	0.030	0.781
NAC Information Gathering/Providing Adequately Addressed	1.000	0.023	0.804
Interest Coverage	0.200	0.020	0.824
FFO to Interest Ratio	0.200	0.020	0.844
FFO to Total Debt Percentage	0.200	0.020	0.864
Total Debt to Total Capital Ratio	0.200	0.020	0.884
Disaster Recovery Ratio	0.200	0.020	0.904
Days to Transition	0.400	0.020	0.924
Certification of Employees Adequately Addressed	0.600	0.014	0.938
Compliance w/Fed., State, Interstate, & Local Laws Adequately Addressed	0.350	0.010	0.948
Licensing, Permitting, & Certification Adequately Addressed	0.350	0.010	0.958
Line Locating; Updating Maps & Drawings Adequately Addressed	1.000	0.010	0.968
Compliance with Base Requirements Adequately	0.300	0.009	0.977
Best Engr & Mgmt Practices Adequately Addressed	0.600	0.009	0.986
English Skills of Employees Adequately Addressed	0.400	0.009	0.995
Level of Awards and Certificates	0.400	0.006	1.001

3.6 Step 6: Alternative Generation

Once the value hierarchy and associated measures have been weighted, the emphasis shifts to identifying alternatives to evaluate against the hierarchy. Evaluation and analysis of these alternatives will give the decision maker additional insight into the decision problem. For this research effort, the original agenda was to obtain proposals from two Air Force bases that were either undergoing or had completed a privatization effort for their electrical system. However, it was discovered that no active, reserve, or air national guard base had privatized their electrical system utilizing the current RFP solicitation process at the time of this research. Additionally, there were no bases currently privatizing their electrical systems. Therefore, the model was tested against notional data sets generated using a random number generator.

Assuming a uniform distribution, a random number generator was used to create 500 data sets, each consisting of 26 data points (26 measures). To reduce this number to a more manageable level, filters were used to maximize the value of each of the first and second-tier values (a total of 11 values). Maximizing two of the values, Cost and Recency, produced the same results; thus, there were 10 proposals (instead of 11) identified for detailed analysis using this filtering process.

As a general rule, the analyst maximized the measure(s) beneath the value being maximized in rank order according to their local weights and then continued the process using the global weights of all other measures. For example, to maximize the Reliability value, only proposals that maximized the score on the "Capital Upgrades and Renewals and Replacements Plan Adequacy" measure were included. This reduced the number of proposals from 500 to 134. Since there were no other measures under the Reliability

value, the analyst used the rank order list of global weights to continue the filtering process. The measure with the highest global weight was "CEA NPV % of Should Cost." Maximizing this measure reduced the list from 134 to 4 proposals. The measure with the next highest global weighting was "% of Positive Past Performance Surveys." Maximizing this measure reduced the list to a single proposal. This general process was used for each of the 11 values in either the first or second tier of the hierarchy. To facilitate the process, the measures were numbered as shown in Table 17. The results of the overall filtering process, shown in Table 18, represent the alternatives to be scored in the next step of the VFT process.

Table 17. Numbering System for Evaluation Measures

Measure	Number Assigned
Interest Coverage	M1
FFO to Interest Ratio	M2
FFO to Total Debt Percentage	M3
Total Debt to Total Capital Ratio	M4
Disaster Recovery Ratio	M5
Compliance w/Fed., State, Interstate, & Local Laws Adequately	M6
Compliance with Base Requirements Adequately Adressed	M7
Licensing, Permitting, & Certification Adequately Addressed	M8
Line Locating; Updating Maps & Drawings Adequately Addressed	M9
Best Engr & Mgmt Practices Adequately Addressed	M10
Level of Awards and Certificates	M11
Certification of Employees Adequately Addressed	M12
English Skills of Employees Adequately Addressed	M13
NAC Information Gathering/Providing Adequately Addressed	M14
Capital Upgrades & Renewals and Replacements Plan Adequacy	M15
Hazmat/Hazwaste Minimization Adequately Addressed	M16
Service Providance Adequately Addressed	M17
Spill Contingency Plan Adequacy	M18
Days to Transition	M19
Transition Plan Adequacy	M20
CEA NPV % of Should Cost	M21
% of Positive Past Performance Reviews	M22
# of Similar Scope Systems in Last 1-3 Years	M23
# of Similar Scope Systems in Last 4-5 Years	M24
% of Similar Scope Systems in Last 1-3 Years	M25
% of Similar Scope Systems in Last 4-5 Years	M26

Table 18. Alternatives Chosen from Notional Data Sets

Alternative	Value Being Maximized	Proposal	Measures Filtered (In Order)
A1	Capability/Risk	P89	15,17,18,16,20,14,3
A2	Cost (Recency)	P389	21,15,23&25 (23,24,21)
A3	Past Performance	P488	22,23,25
A4	Economic Feasibility	P260	1,2,3,4,5
A5	Quality	P354	14,12,6,8,9,7
A6	Reliability	P285	15,21,22
A7	Service/Interruption & Contingency Responsiveness	P83	17,18,16,21
A8	Smooth Transition	P297	20,19
A9	Competency	P216	22,21
A10	Relevancy	P333	25,26

3.7 Step 7: Alternative Scoring

The final step in the process prior to performing analysis on the alternatives is actually scoring the alternatives. For this research, alternative scoring was part of the alternative generation since the scores were used to generate notional data sets. A full list of the scores for each randomly generated and systematically selected proposal is included at Appendix C.

Chapter 4. Results and Analysis

This chapter presents Steps 8 and 9 of the value focused thinking (VFT) process. In Step 8, a rank-ordered list of the alternatives is generated using deterministic analysis. Insight is also obtained regarding the values having the greatest impact on each alternative's final score. In Step 9, sensitivity analysis is performed by varying the weights assigned to the values or measures and evaluating the respective changes in the deterministic results. The sensitivity analysis gives the decision maker insight into how changes in the model weighting might affect the rank-ordering of the alternatives. Sensitivity analysis also gives the decision maker insight into which values and measures cause the decision to be particularly sensitive to weight changes; it also depicts how sensitive the decision problem is to those weight changes. Since notional data was used for this research, the analysis presented in this chapter is provided only as an example of the potential insight to be gained from the model if applied to a real-world source selection scenario.

4.1 Deterministic Analysis

As previously discussed, the deterministic analysis is performed using an additive value function which mathematically combines the "value" points earned by each measure and the weights specified in the model to determine a rank order of the alternatives based on a total value scale of 0 to 1. Figures 18 and 19 show the overall ranking of the alternatives for this research, with the "value" points being earned ranging from 0.806 for Alternative 6 to 0.510 for Alternative 4. There are relatively clear breaks

between most of the alternatives with the closest point of contention being between Alternatives 3 and 8. Alternative 6 would appear to be fairly superior based on this ranking and is the recommended alternative from this data set.

Figure 19 provides additional detail regarding how each of the alternatives scored against the first-tier values of Capability/Risk, Cost, and Past Performance. Although Alternative 6 does not have the highest score against any of the three first-tier values, it scores well against all of them and the balanced results give it a higher total score than any of the other alternatives. Recall that the Capability/Risk value has a global weight of 0.500 and accounts for half of the potential value in the model. Even though Alternative 1 scored the highest against this value, it is ranked second overall. Thus, Figure 19 is a good illustration of the tradeoffs being made within this multi-objective decision analysis.

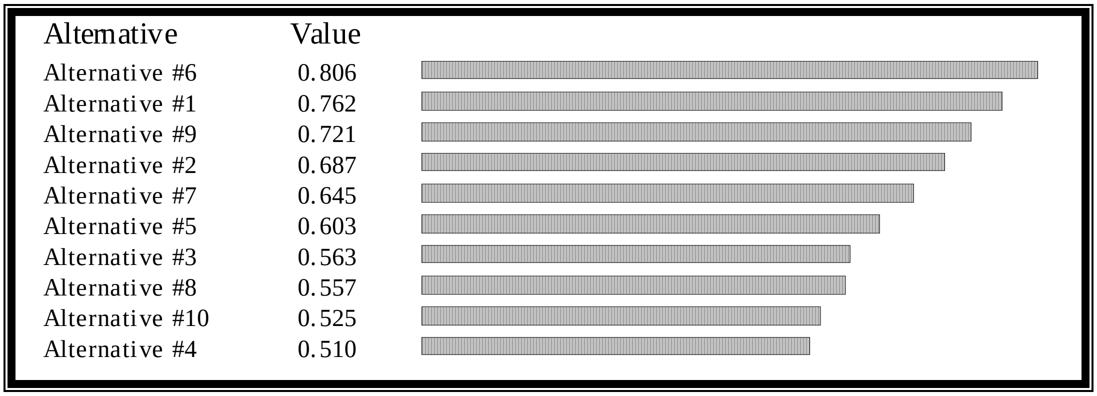


Figure 18. Overall Ranking of Alternatives

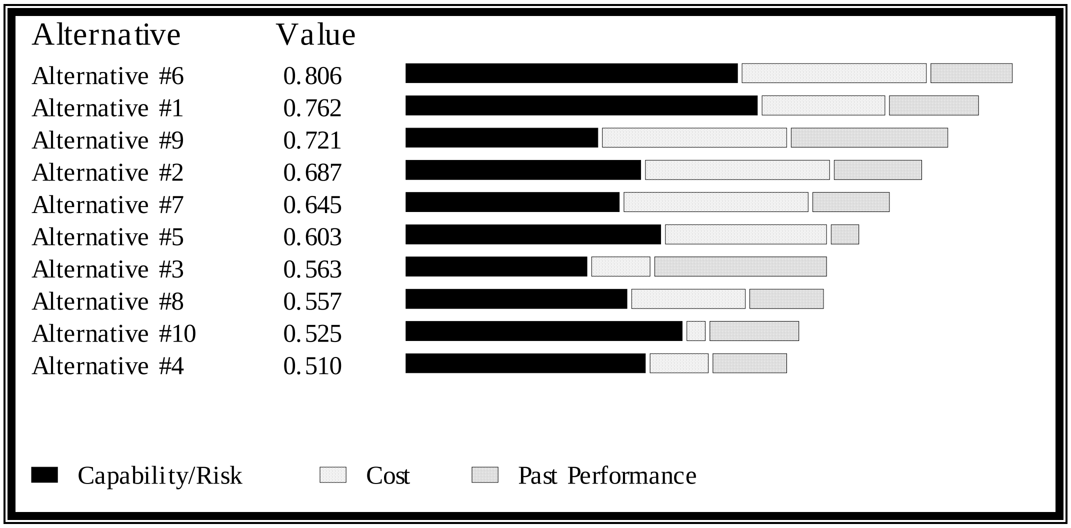


Figure 19. Overall Ranking with First-tier Breakout

For another look at the overall alternative rankings, Figure 20 provides a breakout of the top 12 measures (which account for 80.4% of the model's value) with the remaining 14 shown as a lump sum. As would be expected, although the Cost value only has a global weight of 0.250, the only measure below it, "CEA NPV % of Should Cost," has the most potential influence on the decision because its global weight is also 0.250, which is the highest global weight among the measures. Another interesting point is that although the "CEA NPV % of Should Cost" and "Capital Upgrades and Renewals and Replacements Plan Adequacy" measures account for a great deal of value in the top four alternatives, their combined value does not override the rest of the measures. This again highlights the tradeoffs inherent in this type of decision analysis and the necessity of creating a model that captures all of the relevant values.

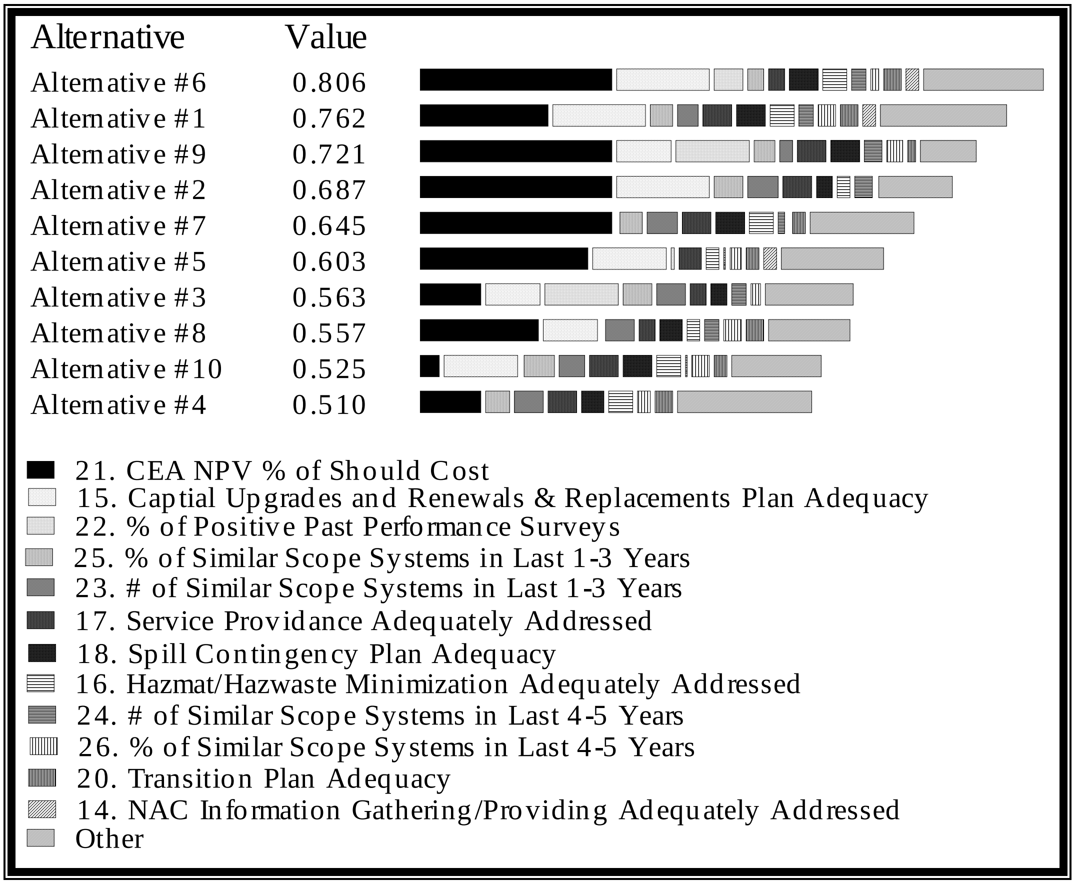


Figure 20. Overall Ranking of Alternatives with Measures Breakout

In addition to the overall ranking, additional insight can be gained from examining the deterministic analysis results for each of the values in the hierarchy. This information could be used when initiating discussions and seeking clarifications with contractors during source selection or when explaining to contractors why they were not awarded the utilities privatization contract. For example, Figure 21 shows the scores of the alternatives against the first-tier value, Capability/Risk, broken down into the second-tier values beneath it. Based on this value alone, Alternative 1 is the highest ranked proposal. Shown in this manner, further insight is provided regarding the lower ranked alternatives. For instance, suppose the contractor for Alternative 9 is interested in its overall third place ranking. From Figure 21, it can be seen that Alternative 9 scored poorly against the Capability/Risk value. Figure 21 also provides further insight and shows that Alternative 9 scored poorly in all five of the second-tier values. To examine more specifically the cause for these poor scores, the alternative rankings could be further refined by examining the impact of each specific measure. From Figure 22, it can be seen that Alternative received zero value for four of the nine measures under Quality. When compared with the top ranked alternatives against Capability/Risk (Alternatives 1 and 6), the "NAC Information and Gathering Adequately Addressed" measure is highlighted as a particular weakness. This type of insight would prompt reexamination of the scores for these measures as well as provide areas for discussion and clarification with the contractor.

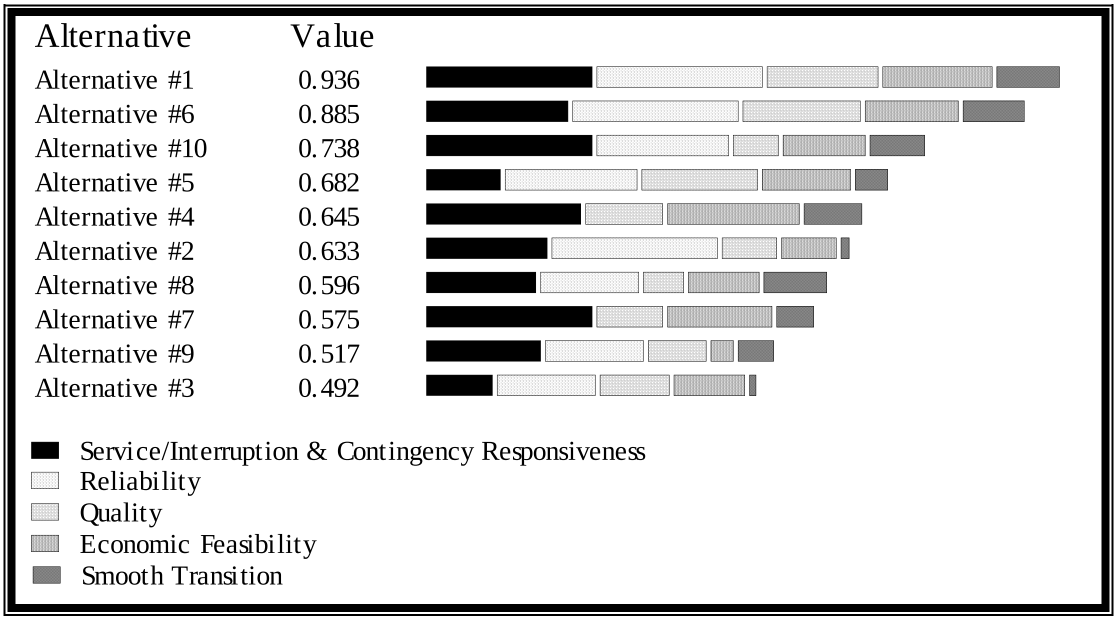


Figure 21. Alternative Rankings against Capability/Risk Value

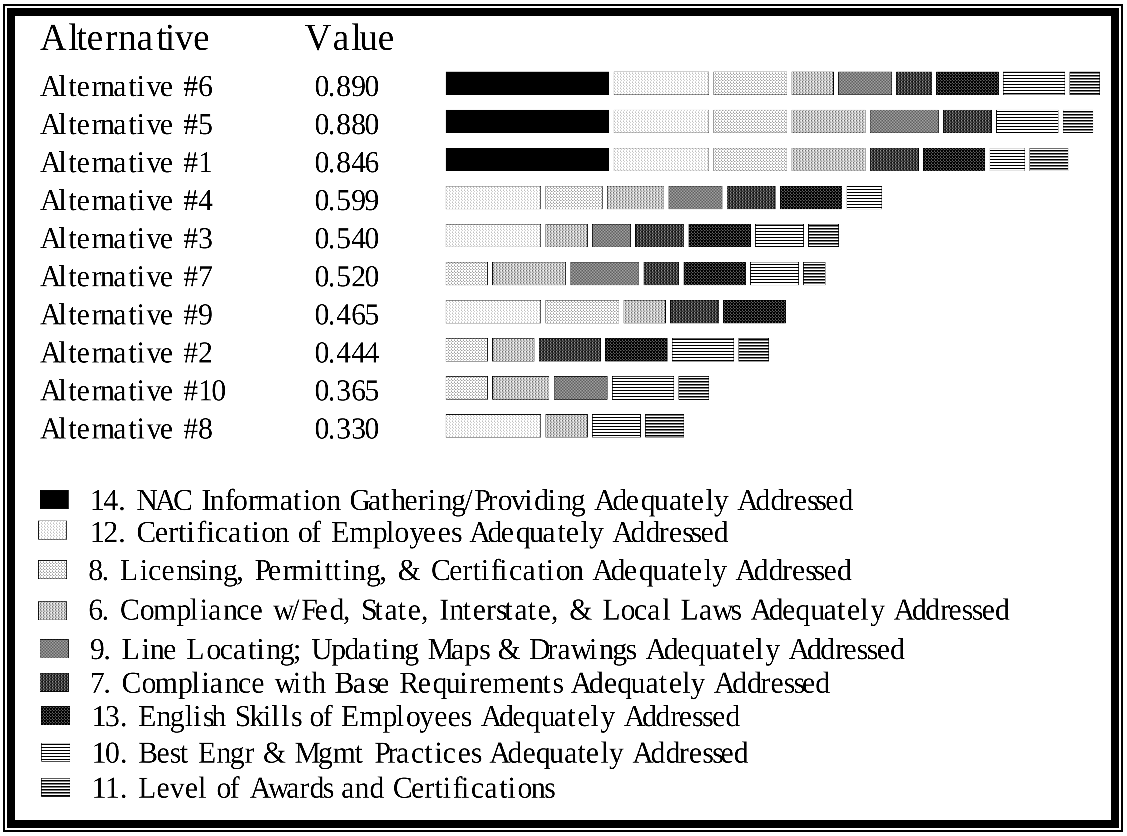


Figure 22. Alternative Rankings against Quality Value with Measures Breakout

During the source selection process, the Source Selection Authority (SSA) often has to narrow their options to a group of proposals that are considered the most competitive. This group of proposals represents what is termed the competitive range. Deterministic analysis could be used to establish a competitive range during the source selection process. If the competitive range was based on the costs proposed by each contractor, a simple deterministic analysis as shown in Figure 23 may indicate that a defendable competitive range would be Alternatives 2, 6, 7, 9, 5. There is a distinct separation between these five alternatives and the other five. However, if the competitive range was based on the Past Performance value, the task would be slightly more difficult. As illustrated in Figure 24, the top two Alternatives (3 and 9) score much higher than the

rest of the alternatives; furthermore, seven of the eight remaining alternatives are grouped together without much separation between them. Therefore, the use of Past Performance criteria alone would result in either a very narrow or very wide competitive range for this set of alternatives.

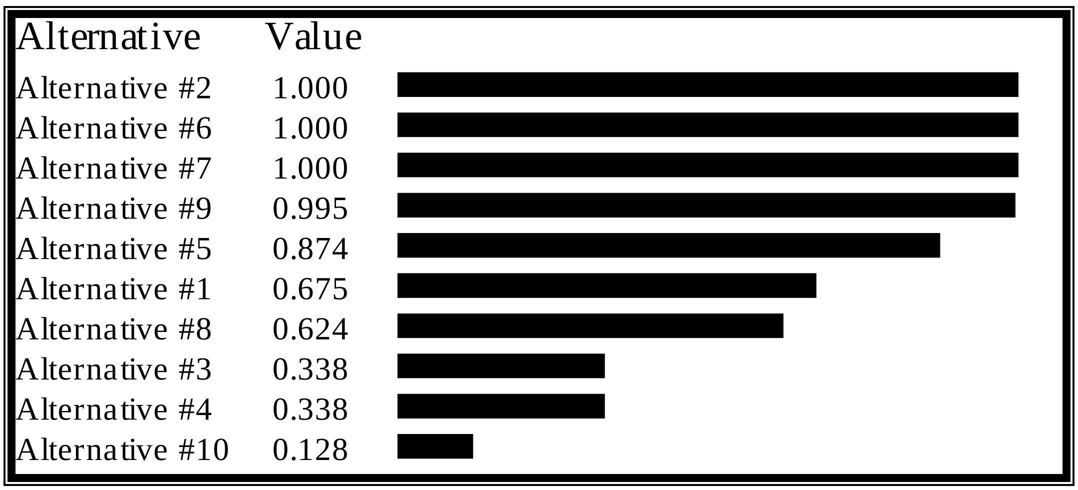


Figure 23. Alternative Rankings against Cost Value

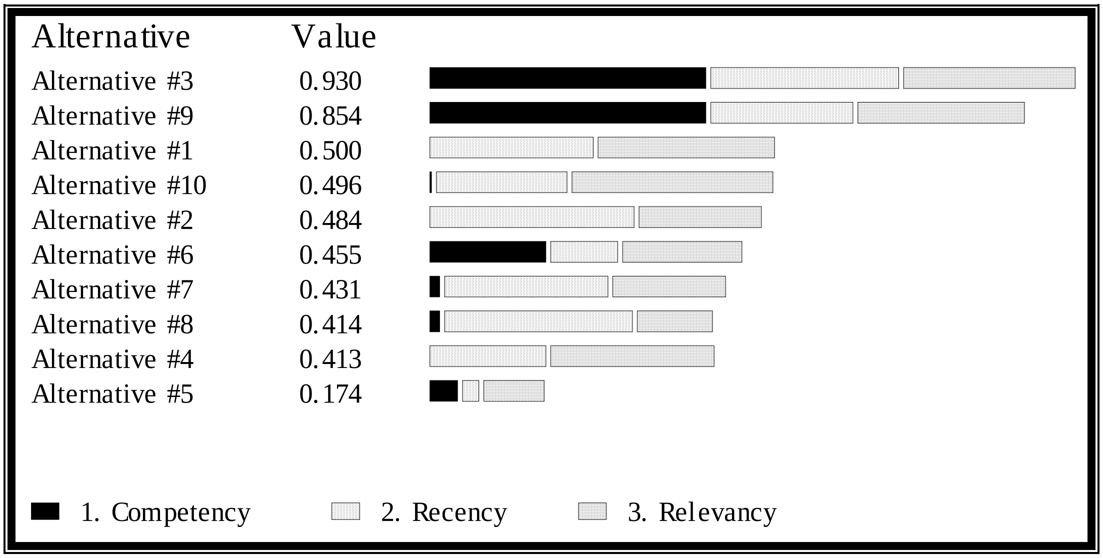


Figure 24. Alternative Rankings against Past Performance Value

4.2 Sensitivity Analysis

The use of sensitivity analysis on the results can provide additional insight into the decision problem. Sensitivity analysis is one of the great advantages of using a model; it allows the analyst to determine how changes in model assumptions impact the deterministic analysis of the alternatives (Kirkwood, 1997). By varying the weights defined by the decision maker and recalculating the additive function repeatedly, the impacts of changes in the weighting scheme on the overall decision problem can be determined. In other words, sensitivity analysis can show how the decision changes in response to changes in the model, identify unnecessary values or measures, and highlight measures that it would be wise to analyze closely

Sensitivity analysis was initially performed on the first-tier values (Capability/Risk, Cost, and Past Performance). As the weight assigned to a particular

value was allowed to range from 0 to 1, the global weights for the other values on the same tier were maintained proportionally constant. The sensitivity graphs presented in this section assign differing line types based on the alternative's rank when the global weight is 1.000; this ranking and the associated line types are displayed beside the right-side vertical axis.

Figure 25 shows the result of varying the global weight assigned to the Capability/Risk value. Recall that at the initial weight of 0.500, Alternative 6 was ranked highest. From this graph, it can be concluded that the decision is sensitive to these changes in weight; however, it would take a decrease in weight from 0.500 to approximately 0.320 to change the decision from Alternative 6 to Alternative 9. Conversely, it would take an increase in weight to approximately 0.720 for the decision to change to Alternative 1. Since the weights for the first-tier values were most likely appropriately distributed by the PDM, the weight assigned to Capability/Risk will probably not vary by the amounts necessary to change the decision. Therefore, from a practical viewpoint, the decision is not considered very sensitive to the weighting of Capability/Risk and the PDM does not need to make a detailed reexamination of the weight placed on this value.

As evidenced by its steeply sloping line, the ranking of Alternative 9 is very sensitive to changes in the weight assigned to the Capability/Risk value. This would indicate that the scores Alternative 9 received in this area may warrant further examination; it also confirms the observations made from the deterministic analysis. Another observation is that an increase in weight generally only serves to further differentiate Alternatives 6 and 1 from the rest of the group in terms of value earned. If

the PDM decided that Capability/Risk deserved more weight or was the only first-tier value that should be considered, Alternatives 1 and 6 may be the only alternatives to consider from this data set.

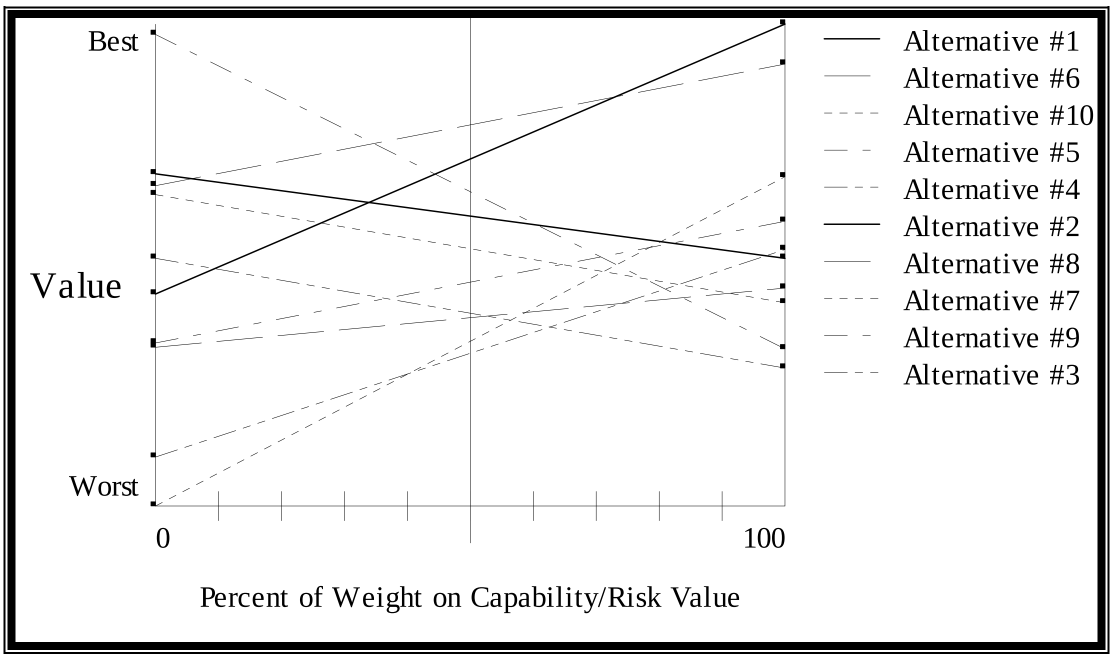


Figure 25. Sensitivity Graph for Capability/Risk Value

Figure 26 shows the result of varying the global weight assigned to the Cost value, which is an example of how a value or measure might be sensitive to weight changes in one direction but insensitive to weight changes in the other direction. From this graph, it can be seen that the decision is sensitive to a decrease in weight, although the decision does not switch from Alternative 6 to Alternative 1 until the global weight declines from 0.250 to approximately 0.130. However, the decision is insensitive to an

increase in weight since increasing the weight does not switch the decision at any point. Because the weights on the first-tier values are not likely to be altered drastically, these observations indicate that the PDM should not devote a great deal of time and effort to making minute changes to the cost weight.

Figure 26 also shows that as the weight on the Cost value approaches 0.000, the alternative scores are relatively tightly bunched together in terms of value. Conversely, as the weight approaches 1.000, there is noticeably more spreading of the value. This shows that cost differentiates between the alternatives very well; therefore, the scores for the measure under the Cost branch should be looked at closely. By observing the slope of the lines for Alternatives 7 and 10, it can be seen that their ranks are very sensitive to changes in the weight on the Cost value. This would indicate that the scores for these two alternatives may warrant further examination.

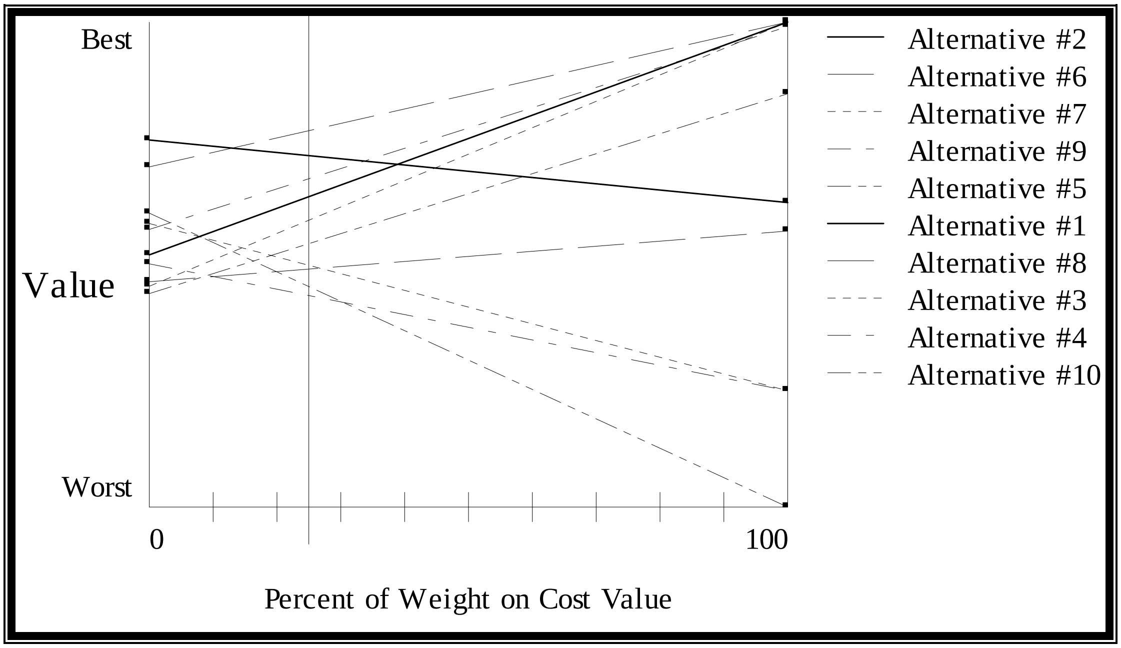


Figure 26. Sensitivity Graph for Cost Value

Figure 27 shows the result of varying the global weight assigned to the Past Performance value. From this graph, it can be seen that the decision is insensitive to decreases in the weight but sensitive to increases in the weight. An increase in the global weight from 0.250 to approximately 0.390 changes the decision from Alternative 6 to Alternative 9; when the weight is increased to approximately 0.750, the decision changes to Alternative 3. Despite the increases in weight resulting in two changes to the recommended decision, the PDM should not devote a great deal of time and effort to making minute changes to the cost weight since its weight is not likely to be altered drastically by the PDM.

Figure 27 also shows that only Alternatives 3 and 9 increase in value with an increase in weight on the Past Performance value and differentiate themselves from the

other alternatives. This may warrant additional investigation to ascertain what is causing the differentiation. The rankings of Alternatives 3 and 5 appear to be the most sensitive to changes in the weighting, which would also indicate that additional investigation may be needed.

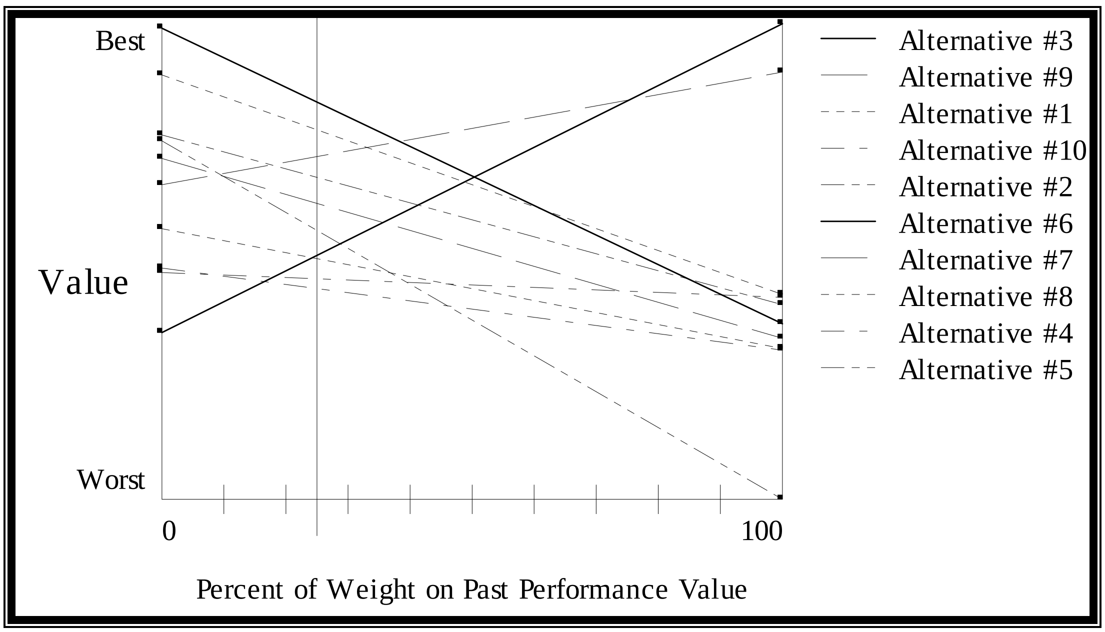


Figure 27. Sensitivity Graph for Past Performance Value

The sensitivity graph for the Quality value, Figure 28, shows another scenario that might be encountered. In this case, the decision is completely insensitive to any change in weight on the Quality value; Alternative 6 remains the best alternative no matter how the weight on the value is varied. This can be an indicator that a value is not necessary to evaluate the decision for the set of alternatives being examined. The graph also shows that the rank of Alternative 5 is very sensitive to changes in the weight on the Quality

value. If the global weight of the Quality value was increased to 1.000 then it would be a very close second to Alternative 6 in ranking. This would indicate that the scores for alternative 5 may need to be more thoroughly examined. It can also be seen that increasing the weight on Quality to 1.000 severely differentiates the top three alternatives (6, 5, and 1) from the rest. This may be another indication that the scores obtained on the measures under quality may warrant further study.

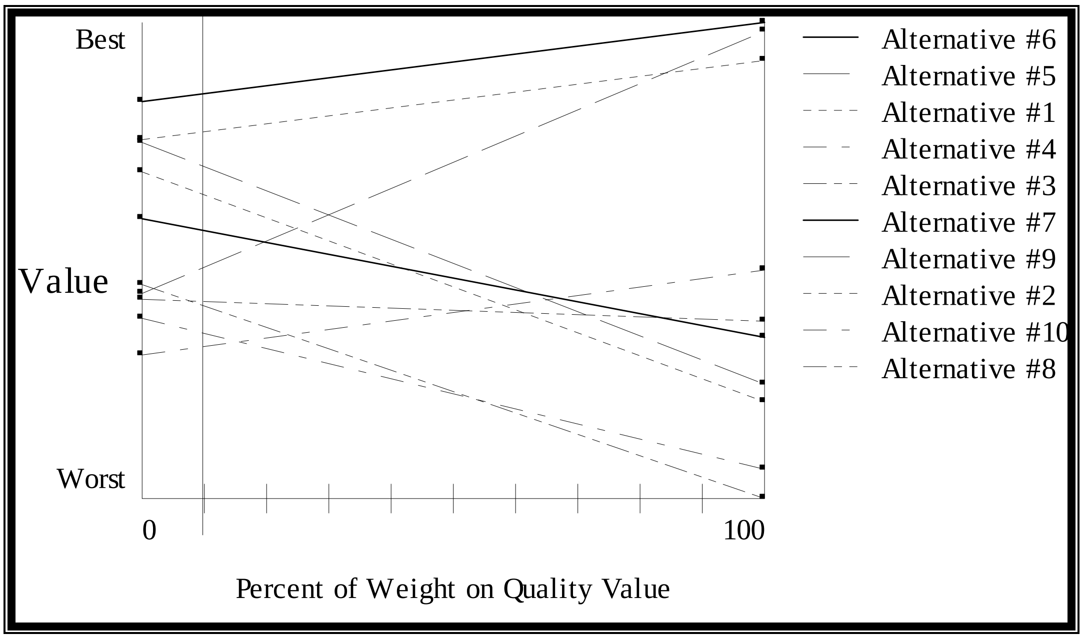


Figure 28. Sensitivity Graph for Quality Value

Figure 29 illustrates that, in addition to conducting sensitivity analysis on the values within the model, the analyst can also conduct sensitivity analysis on each specific measure. This can be valuable in determining which measures might require more or less

time in terms of defining, gathering data, and scoring. It can also highlight measures that may be unnecessary to the model.

Figure 29 shows that the decision is completely insensitive to any change in weight on the "NAC Information Gathering and Providing Adequately Addressed" measure; Alternative 6 remains the best alternative no matter how the weight on the value is varied. The graph also shows that the rank of all ten alternatives is very insensitive to changes in the weight on this measure. This can be an indicator that a measure is not necessary to evaluate the decision for the set of alternatives being examined. Figure 29 also once again confirms the observations made from the deterministic analysis about Alternative 9.

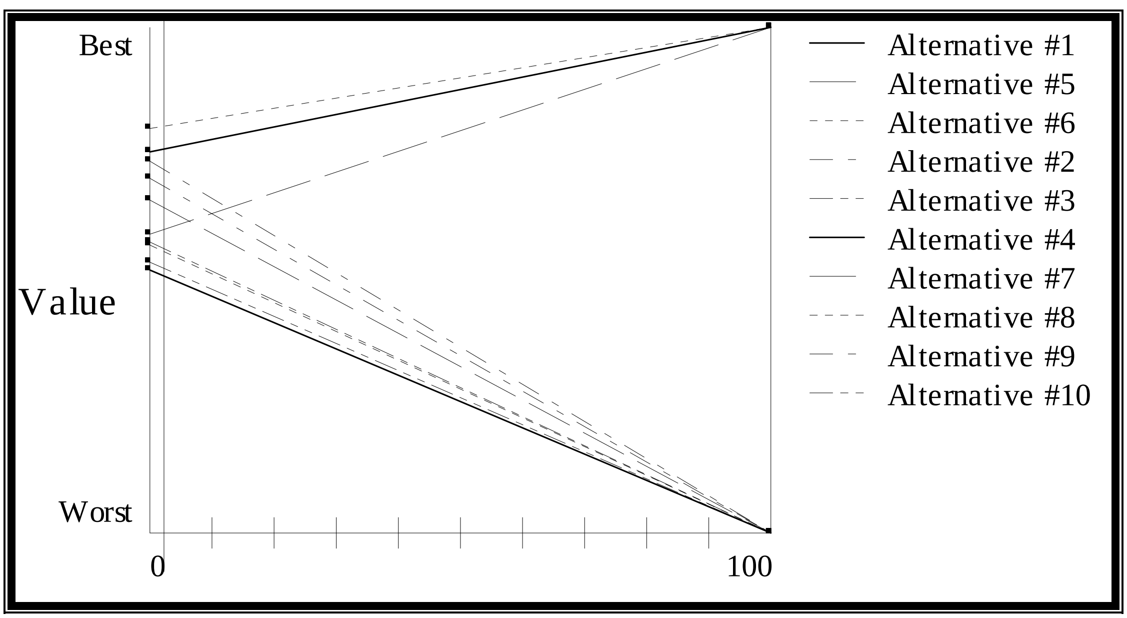


Figure 29. Sensitivity Graph for NAC Information Gathering and Providing Adequately Addressed Measure

Chapter 5. Findings and Conclusions

This chapter represents Step 10 in the value focused thinking (VFT) process and provides a short summary of the results of the research effort while answering the research questions that were posed in Chapter 1. It will also present recommendations for implementation of this model within the utilities privatization process, highlight the strengths and weaknesses of the model, and identify avenues for further research within this field.

5.1 Process Overview

This VFT model was constructed for use as a multiple objective decision analysis tool to aid decision makers in selecting the best contractor during the source selection process of a utilities privatization effort. During this process the ten-step method outlined by Shoviak (2001) was used to create the model as well as to answer the research questions that were presented in Chapter 1. Recall from Chapter 1 that the research questions were:

1. What values does the Air Force hold regarding utilities privatization? What measures can be developed and used to accurately represent and evaluate those values?

2. Which values affect the contract award decision most? Will this hold true at all bases and throughout the process at each base?

3. Will one set of values hold true for all utility systems (i.e., electrical, water, wastewater, and natural gas)? Can the value hierarchy be held constant with changes made only in the measurements, value functions, or weights for each system evaluation?

The first research question was answered by using the first five steps of the VFT process. The resulting hierarchy consisted of three first-tier values: Capability/Risk, Cost, and Past Performance. These values were further decomposed into eight second-tier values and five third-tier values. To measure the level of attainment for these values 26 measures and appropriate value functions were developed. Local and global weighting were applied to both the measures and values.

The second question was answered by using Steps 6 through 9 of the VFT process. Once the hierarchy was developed, the generation and scoring of a set of viable alternatives was accomplished. This was done by creating a set of 500 randomly generated proposals, using filters to select ten of the proposals to maximize each of the 11 first and second-tier values, and scoring the proposals. Deterministic and sensitivity analysis was then conducted on the ten alternatives.

In answering question two it can be seen from the deterministic and sensitivity analysis that the decision was most affected by the Capability/Risk value and the “CEA NPV % of Should Cost” measure. Examining the model and associated global weights, it is tempting to say this is intuitive; however, the impact of the measures and values contained in the model is very dependent on the alternatives evaluated with the model. A different set of proposals could (and probably will) provide completely different results and analysis findings. Therefore the answer to the second half of question two is that although the impact of the values and measures may hold the same at each base, it is just as possible that it will not.

The third question was answered by referring to the research used in creating the hierarchy. The Request for Proposal (RFP) template distributed by the Air Force Civil

Engineer Support Agency (AFCESA) was created for use with all utility systems. Since the value hierarchy is heavily based upon the RFP template, it can be used to evaluate all utility systems with no change to the values, measures, single dimension value functions (SDVFs), or weights. However, in order to achieve the most helpful and insightful results, it would be better to reevaluate the model for use with other systems and make adjustments as necessary. The biggest changes would probably be to the scale definitions for each measure since they were created specifically for electrical systems.

5.2 Conclusions

Two main conclusions can be drawn from this research: VFT is a viable technique for source selection evaluations and the hierarchy is general enough that it can be used with a variety of utility systems with very minor changes. VFT focuses the source selection decision process on the preferences, opinions, and views of the Air Force and allows the quantification of the subjective evaluation of each proposal. This allows an objective look at how each alternative ranks against the others deterministically; it also allows the decision maker to view how sensitive the decision is to changes in the model. These insights provide the decision maker with additional information that may not have been obvious simply by evaluating proposals through an alternative focused thinking perspective. The applicability of this model to various utility systems implies that it can be integrated directly into the RFP process as a secondary check on the current evaluation process. After all, Orwin (1999) stated that not only is a standardized source selection process needed, but a backup source selection tool should also be used in order to double check the "accuracy" of the other process.

5.3 Model Strengths

This model provides an economical means of replicating and testing decisions and is quicker to evaluate than the real life system it represents. In addition, this model can be used to evaluate numerous scenarios; therefore, it is much more feasible to implement and use than a trial and error methodology. This model also requires the decision maker to closely examine the decision to be made providing invaluable insight and understanding into the decision. It also eliminates bias and common errors from the decision by providing a systematic evaluation method and eliminating the tendency of humans to “fly by the seat of their pants” and use “rules of thumb” (Post & Anderson, 2003).

This VFT model also takes into account the values (information, opinions, and preferences) of the decision maker (in this case the United States Air Force) (Kirkwood, 1997). It represents what the Air Force cares about and what is fundamentally important to this specific decision situation (Keeney, 1994). These values are the driving force for the decision making process and allow the Air Force to identify alternatives that more completely and satisfactorily match their fundamental values. Another particularly effective advantage of this model is the ability it gives the decision maker to implement changes to the model parameters to reflect minor differences such as those found between utility systems and to reflect changing preferences (such as those of a different decision maker). It also allows easy inspection of the model’s sensitivity to changes in the parameters; this is particularly useful in situations such as utilities privatization where the impact of the decision is so tremendous and maximum insight is desired.

5.4 Model Limitations

This model also has several limitations. One major limitation of this model is that it was developed using a single proxy decision maker. Although the VFT process and the use of doctrinal publications to facilitate hierarchy development helped reduce the introduction of bias into the model, having a single proxy tends to create bias. If the model is used with real world proposals, the scoring of the proposals also inherently introduces some bias into the outcome. However, since a VFT model is only meant to provide insight and aid the decision maker in choosing an alternative, the small amount of bias present in the model can be handled provided the decision maker realizes it is present.

Another possible limitation present in the model is the inclusion of cost as a value within the hierarchy. A potentially more useful way to analyze proposals during a source selection would be to evaluate cost separate from the rest of the hierarchy and then do a cost/benefit ratio analysis after scoring is complete. This could provide the decision maker with a clearer picture of the tradeoffs between the potential benefits of the privatization effort with the potential cost.

Another area that could be improved within the model is the measure(s) under the second-tier value of Competency. When developing the model, the original intent was to have a separate measure of "% of Positive Past Performance Surveys" for each major category of evaluation within the past performance surveys used during source selection. However, because no source of a past performance survey could be found, the single measure was used. Added accuracy/benefit could be gained by including separate measures for each past performance survey category.

5.5 Areas for Future Work

One plausible area for future work would be gaining additional validation or adjustments for the model from the Air Force Civil Engineer Support Agency (AFCESA), the Defense Energy Support Center (DESC), or senior Air Force leadership. This would help to ensure the model truly incorporates the values of the Air Force with regards to utilities privatization and provide additional confidence in the insight provided by the model. Another area for future work would be working with AFCESA to implement this source selection evaluation tool into the current source selection process. This would be extremely beneficial to the Air Force by providing them with a second source of insight into source selection decisions that is objective, repeatable, and defendable. A third avenue for future work would be analyzing actual source selection decisions using this tool. This would not only allow deterministic analysis and sensitivity analysis to be performed on those particular proposals, but it would also allow a comparison of the insight gained from the current source selection process with the process represented by this model. From this comparison, additional improvements could be determined for each process.

Appendix A. Value Hierarchy Definitions

Capability/Risk

The Capability/Risk value and the sub-values identified in that branch are concerned with the capability of the contractor as portrayed in the contractor's proposal and the feasibility of the plans, work, and costs outlined in the proposal. This is extremely important to the Air Force since one of the core reasons behind privatization is to increase the quality and efficiency of service from the utility system by utilizing private sector expertise, while at the same time maintaining or improving upon current service levels. Capability/Risk is crucial to the utilities privatization decision because a proper assessment of how well a contractor meets the criteria of this value allows the source selection authority to accurately award to the firm that will meet the goals of the privatization initiative. Capability/Risk is further broken down into 5 sub-values: Economic Feasibility; Quality; Reliability; Service, Service Interruption, and Contingency Responsiveness; and Smooth Transition.

Economic Feasibility

Economic feasibility is concerned with the financial condition of the contractors being evaluated and whether or not that condition will affect the status of the contract, the performance of the work, or the stability of the service. This is of great concern to the Air Force in evaluating a contractor because each contractor needs to have a well developed understanding of the economic risk associated with the undertaking and the Air Force needs to have some assurance that the contractors have that understanding.

This is also extremely valuable to the USAF because they must be able to predict the economic stability of the contractors with some degree of certainty in order to alleviate the possibility of bankruptcy, low reinvestment in capital upgrades, lack of new technology use, and other problems associated with poor financial condition of a contractor.

Quality

Quality is a reflection of the Air Force's focus on retaining or improving actual service levels with the implementation of a utilities privatization contract. Service levels can be affected by many things such as governmental laws at all levels, local (base) requirements, management practices, worker safety, and system security. All of these items and quality of service as a whole is very important in a utilities privatization contract, because if the contractors provide the service but fail to meet the action items listed above, then the base can face severe penalties, increased costs and inefficiency, loss of lives, and potential loss of service. These are conditions that the Air Force can not afford, and, therefore, the USAF has to have a firm evaluation of a contractor's ability to provide quality service along with a cheaper product. The quality sub-value is further broken down into six sub-sub-values: Compliance with Federal, State, Interstate, and Local Laws and Base Requirements, Continued USAF Readiness, Effective Base Interaction, Effective Management, Safety, and Security.

Compliance with Federal, State, Interstate, and Local Laws and Base Requirements

This value is concerned with a contractor meeting all laws that affect the operation of the privatized system, maintaining proper licensing, permitting, and

certification processes, and adhering to all base specific requirements such as controlled access areas, the right of way, training of military personnel, and metering. This value is understandably important because it can have such a tremendous impact on the base's public relations, the amount of fines levied against the base, system operations, contractor/government relations, wartime readiness, and base expenditures. Without proper evaluation of this area, the system could become a tremendous liability in the future.

Effective Base Interaction

Due to the importance of a utility system to the base infrastructure system, base employees, and base mission, interaction between the contractor and base organizations such as Civil Engineering is critical. Items such as the locating of utility lines and submetering are crucial daily taskings whose accuracy is relied upon by not only base units, but also other contractors performing work on the base. The Base Civil Engineer is also reliant on the contractor to provide updated maps and drawings of new system components such as facilities and lines. Without the proper locating of lines and updating of maps and drawings, a base or large areas of the base can be left without electricity, water, or natural gas for days, workers can be injured or killed, and the mission of the base can be critically impacted.

Effective Management

Effective management is concerned with ensuring that the contractor employs management practices that will lead to the increased efficiency and service levels expected from the privatization effort. Although by itself effective management does not determine the success of a contractor in operating a system, it is a linchpin of an

operation and a key indicator of a contractor's potential performance. This is important to the Air Force as an indicator of a firm's ability to take on a utilities privatization partnership with a base.

Safety

This value focuses on the safety of the workers that will be operating, maintaining, and managing the utility system in question. Safety issues such as proper certification of the firm's employees and the hiring of workers with proper English skills for the positions filled are important simply for the protection of human lives. These actions also help protect equipment and facilities as well as improving customer service and interaction with base personnel and organizations.

Security

Security is an enormous consideration with a utilities privatization contract because a contractor with non-military, non-government personnel will now be allowed base access every day in order to operate a mission essential utility system. Although the Air Force will impose access restrictions on the contractor personnel, the most effective way to prevent security incidents is proper screening of potential employees. Therefore potential contractors have to be evaluated on their plans for helping to maintain the security of a base as well as helping the USAF properly screen employees through National Agency Checks and routine records checks.

Reliability

Reliability is extremely important to the Air Force because of the significant impact that intermittent delivery of utility services would have on an Air Force Base's personnel, facilities, activities, and overall mission. Since an Air Force Base is

essentially a self-contained small town that is completely reliant on the utility systems that support it, reliability of those systems is crucial the base as a whole. Increased reliability is one of the core reasons behind the push for utilities privatization and therefore is an integral piece of the source selection process. The Air Force needs to have an accurate picture of how a contractor will affect the system reliability and how they plan to upgrade the system as well as perform renewals and replacements of the system components. Having a grasp on these plans allows the Air Force to develop a fairly accurate picture of how reliability will be impacted.

Service, Service Interruption, and Contingency Responsiveness

This value not only focuses on a contractors plans and ability to maintain, operate, and repair the system under normal circumstances, but also under austere conditions such as natural disasters, major component failures, hazardous substance spills, cease and desist Notices of Violations, and other situations requiring intense and often specialized procedures. It also looks at prevention of these occurrences through actions such as minimization of hazardous materials used and hazardous waste to dispose of. Accurately predicting how well a contractor will perform in this category is very important to the Air Force because without effective operational plans for dealing with these situations and preventing them, the impact that these disasters have can become debilitating to the base and its mission and the potential for damage to equipment and facilities and loss of life is greatly magnified.

Smooth Transition

Turnover of a utilities system and its operation involves a great deal of coordination and this value reflects the desire of the Air Force to know that the contractor

will be able to efficiently transition to ownership in a timely fashion. By evaluating a firm's plans for an adequate time-phased turnover of the facilities, equipments, permits, and operation and maintenance as well as the responsibility for new construction, meter installation, meter reading and billing, and personnel hiring the Air Force hopes to achieve an accurate appraisal of how much impact the transition will have on base operations and for how long that impact will occur.

Cost

The cost value is focused on the Net Present Value (NPV) of the stream of cash flows that the Air Force would be expected to make to the contractor over the lifetime of the contract. Once again, this is one of the top reasons for privatizing a system. Along with the expectation of increased service levels, a drop in cost is also associated with the utilization of a private firm's greater expertise and efficiency. This is intuitively important to the Air Force because like any organization a base has a limited amount of funding available for operations and therefore every dollar needs to be efficiently utilized.

Past Performance

Past Performance is a top value because it is a good indicator of how confident the Air Force can be that the contractor will perform as promised based on current and previous (within the past 5 years) contract efforts. This confidence level is very important due to the length (permanency) of most utilities privatization contracts and should reflect the apparent experience in owning, operating, or maintaining utility systems of similar size and complexity as the system included in the RFP. The Air Force must have some demonstrable assurance that the contractor can do what they say they

can. Past performance is further broken down into three sub-values: Competency, Recency, and Relevancy

Competency

One factor that the Air Force desires to have demonstrated in a contractor's past performance evaluations is competence in operating, maintaining, and repairing utility systems. The USAF needs to have confidence in the fact that the contractor will perform competently and one available gauge of this is how well they have performed in other similar situations.

Recency

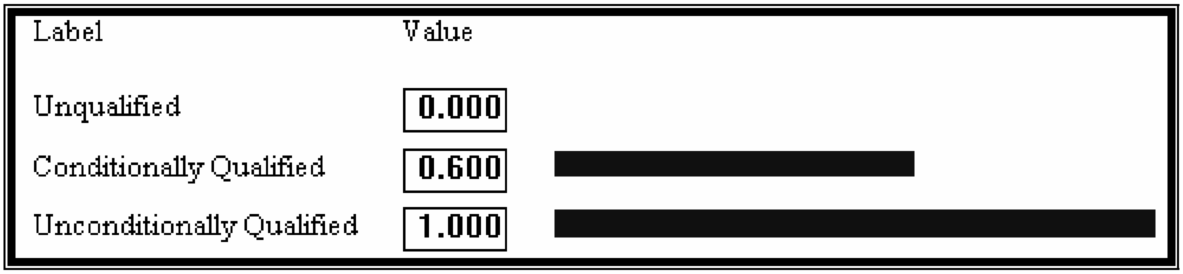
The Air Force not only values how well a contractor has performed on past jobs, but also how recently they have performed contracts of similar scope. This is important because it shows recognition that the personnel base of a firm is always in transition. Like most sectors in the private world, utilities are in constant flux with their personnel, technology, and infrastructure. A contractor that was a top performer ten years ago, may not be a viable choice today.

Relevancy

Along with the competence and recentness of a contractors past performance, the Air Force values the relevancy of a firm's past performance. This is important because even though a contractor may be very large, experienced, and competent, they may not have the experience and competence in operating a utility system. This is a vital distinction to make, because the criticality of utility systems to an Air Force base means that the contractor has to have the immediate know-how to run the system or be faced with an extremely steep learning curve in order to avoid failure.

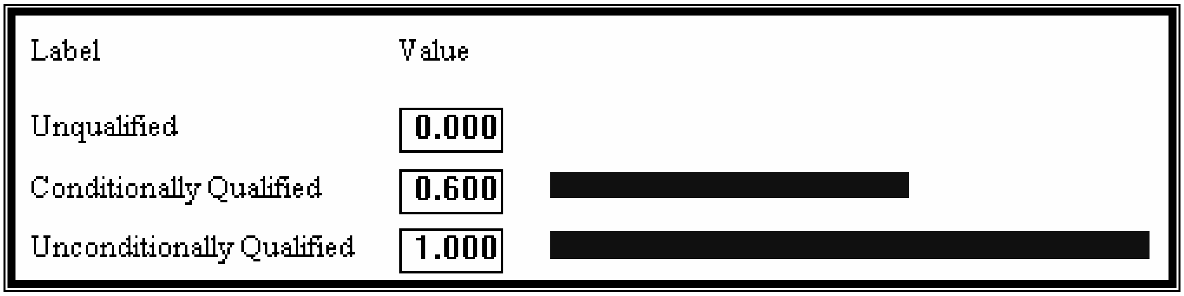
Appendix B. Measure Definitions

M1: Interest Coverage



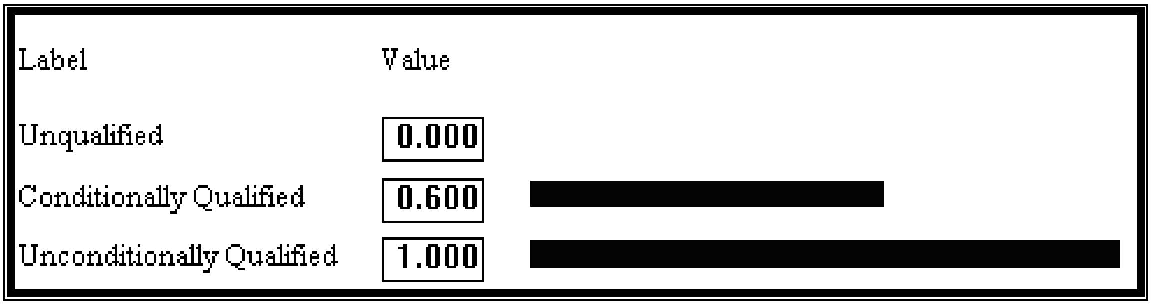
Category	Category Definition	Value
Unqualified	1.0 x or less for Investor Owned system. 1.0 x or less for Municipal or Cooperative Owned system.	0.0
Conditionally Qualified	1.1-2.5 x for Investor Owned system. 1.1-1.5 x for Municipal or Cooperative Owned system.	0.6
Unconditionally Qualified	Greater than 2.5 x for Investor Owned system. Greater than 1.5 x for Municipal or Cooperative Owned system.	1.0

M2: Funds from Operation to Interest Ratio



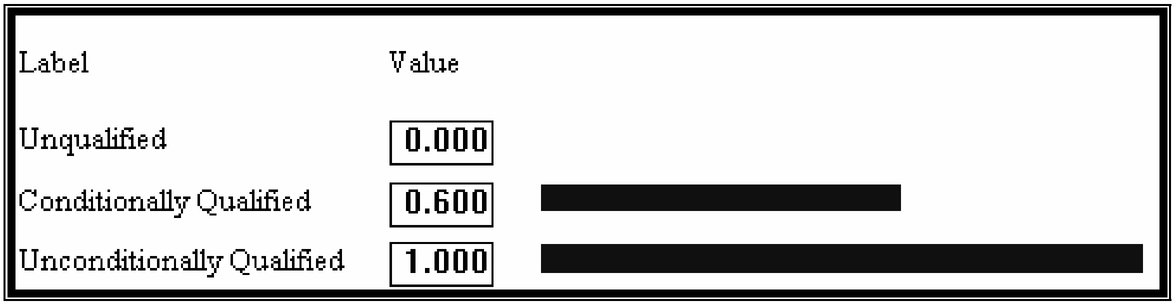
Category	Category Definition	Value
Unqualified	Less than 1.0 x for Investor Owned system. 1.0 x or less for Municipal or Cooperative Owned system.	0.0
Conditionally Qualified	1.0-2.75 x for Investor Owned system. 1.1-1.7 x for Municipal or Cooperative Owned system.	0.6
Unconditionally Qualified	Greater than 2.75 x for Investor Owned system. Greater than 1.7 x for Municipal or Cooperative Owned system.	1.0

M3: Funds from Operation to Total Debt %



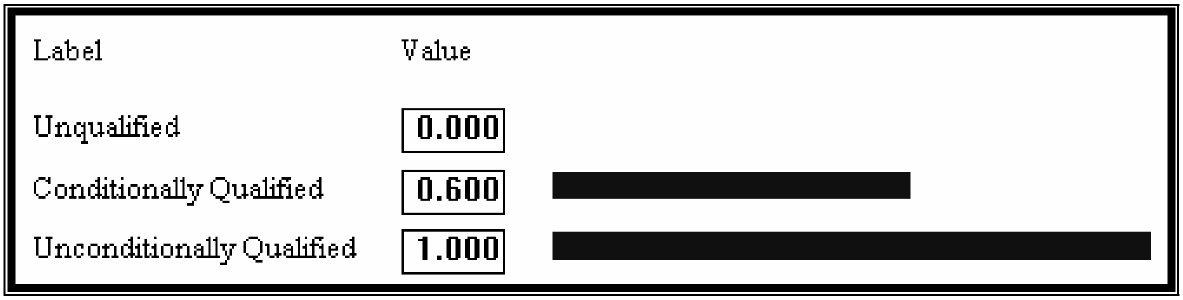
Category	Category Definition	Value
Unqualified	Below 10% for Investor Owned system. Below 7% for Municipal or Cooperative Owned system.	0.0
Conditionally Qualified	10-20% for Investor Owned system. 7-15% for Municipal or Cooperative Owned system.	0.6
Unconditionally Qualified	Greater than 20% for Investor Owned system. Greater than 15% for Municipal or Cooperative Owned system.	1.0

M4: Total Debt to Total Capital Ratio



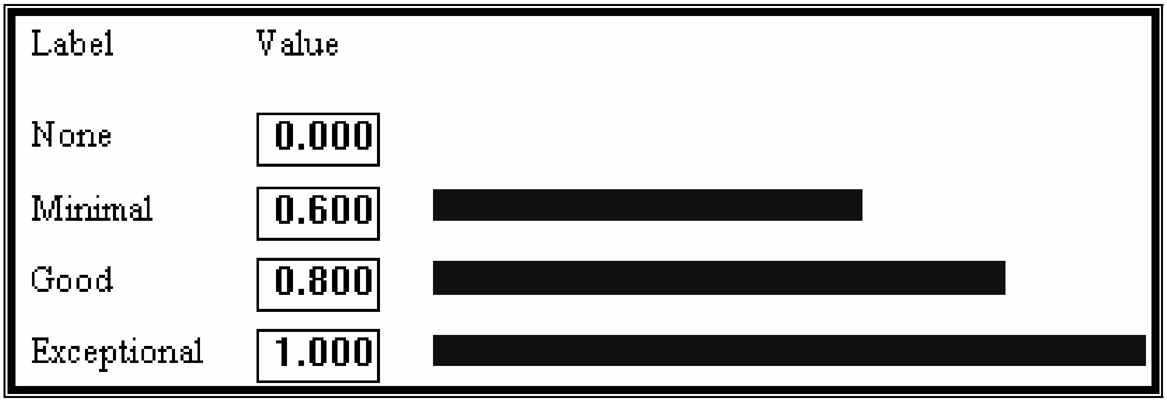
Category	Category Definition	Value
Unqualified	Above 70% for Investor Owned system. Above 80% for Municipal or Cooperative Owned system.	0.0
Conditionally Qualified	50-70% for Investor Owned system. 70-80% for Municipal or Cooperative Owned system.	0.6
Unconditionally Qualified	Below 50% for Investor Owned system. Below 70% for Municipal or Cooperative Owned system.	1.0

M5: Disaster Recovery Ratio



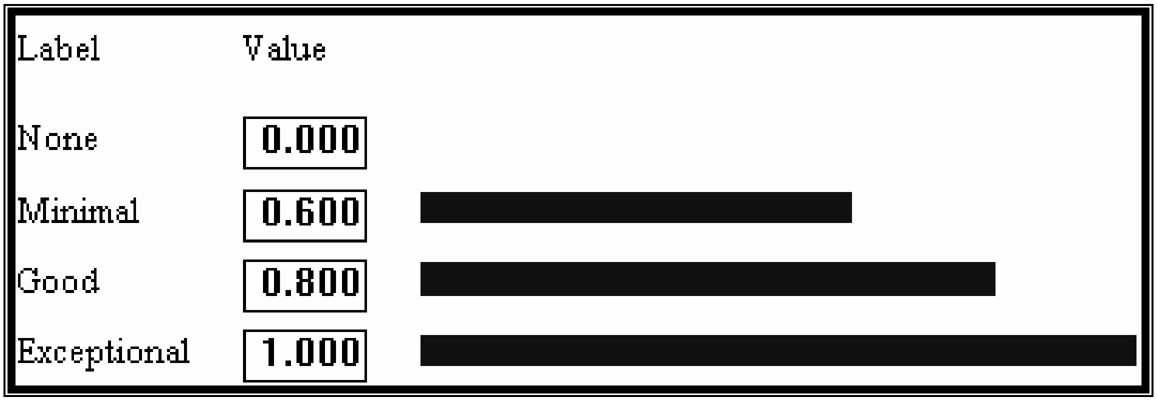
Category	Category Definition	Value
Unqualified	Above 40% for Investor Owned system. Above 40% for Municipal or Cooperative Owned system.	0.0
Conditionally Qualified	25-40% for Investor Owned system. 25-40% for Municipal or Cooperative Owned system.	0.6
Unconditionally Qualified	Less than 25% for Investor Owned system. Less than 25% for Municipal or Cooperative Owned system.	1.0

M6: Compliance with Federal, Interstate, State, & Local Laws Adequately Addressed



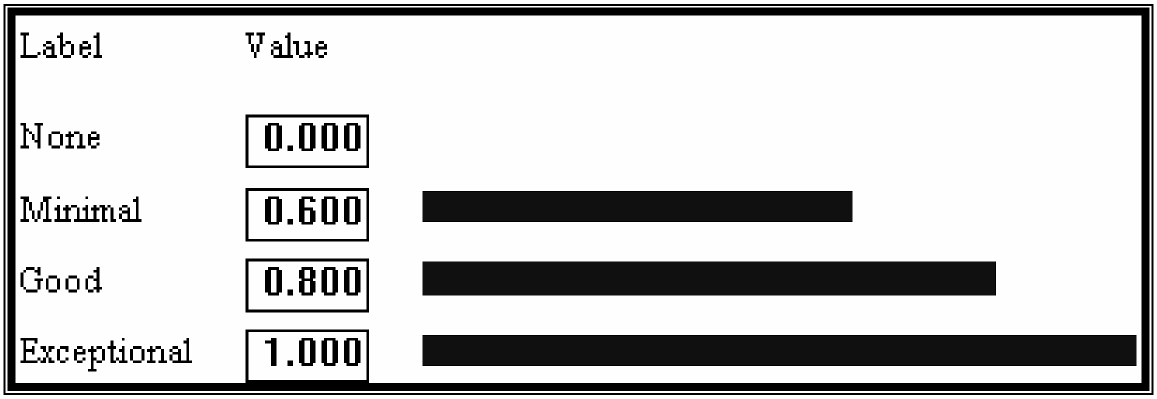
Category	Category Definition	Value
None	Compliance with these laws is not addressed in the proposal.	0.0
Minimal	Proposal shall address all applicable federal, state, interstate, and local laws/regulations that must be complied with in order to provide this service including those requirements relating to health, safety, and the environment (RFP Section C.2.1 and L.6.2).	0.6
Good	Proposal expands to address specifically how each applicable law will affect each portion of the operation and how each facet will be managed to avoid non-compliance.	0.8
Exceptional	Proposal includes all previous and also addresses plan for modifying service practices as applicable laws are dropped, added, or amended. Should include discussion of pending laws and changes to laws.	1.0

M7: Compliance with Base Requirements Adequately Addressed



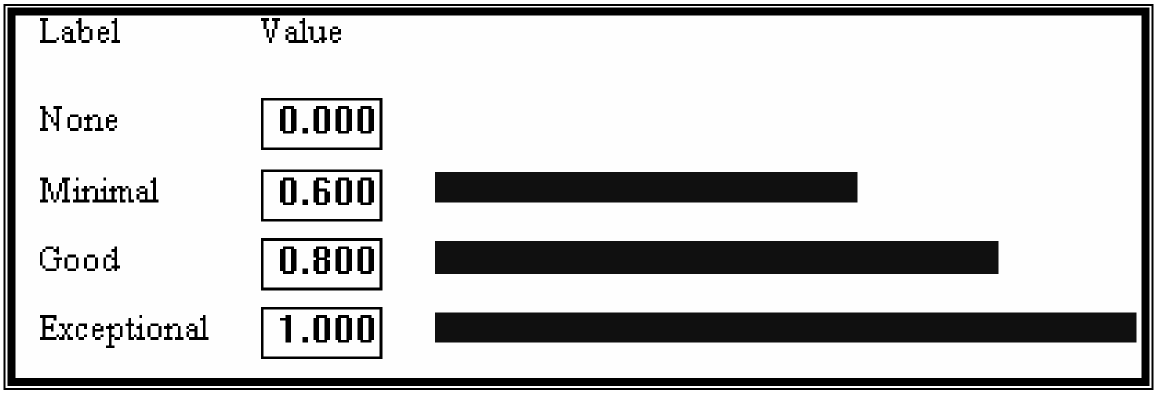
Category	Category Definition	Value
None	Compliance with base requirements is not addressed in the proposal.	0.0
Minimal	Proposal acknowledges and addresses the most current versions of any base-specific requirements as defined in the utility specific attachment (Section J) of the RFP.	0.6
Good	Proposal expands to address specifically how each base specific requirement will affect each portion of the operation and how each facet will be managed to comply with said requirements.	0.8
Exceptional	Proposal includes all previous and also addresses plan for modifying service practices for any requirements that are not being met and if any new or changed requirements are not being met in the future. Should include discussion of pending requirements and changes to requirements.	1.0

M8: Licensing, Permitting, & Certification Adequately Addressed



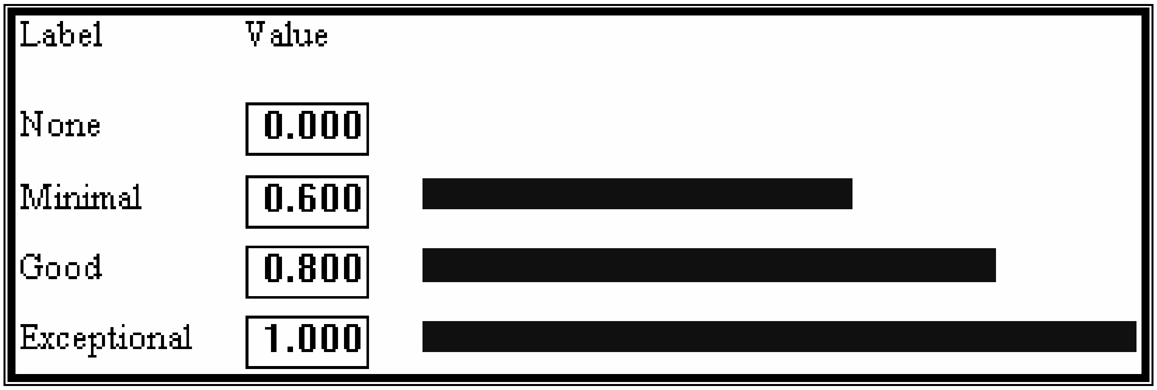
Category	Category Definition	Value
None	Acquisition and transferal of necessary licenses, permits, and certificates is not addressed in the proposal.	0.0
Minimal	Proposal acknowledges and addresses the requirement to obtain and maintain current any and all licenses, permits, or certifications necessary to own, maintain, and operate the utility system (RFP Sections C.3.1, C.10.1, and C.13.5).	0.6
Good	Proposal expands to address specifically each permit, license, and certificate and which areas of the operation are affected by such.	0.8
Exceptional	Proposal includes all previous and also addresses plan for modifying service practices for any permits, licenses, or certificates that cannot be obtained or have been revoked. Should include discussion of any pending requirements and changes to requirements.	1.0

M9: Line Locating and Updating of Maps and Drawings Adequately Addressed



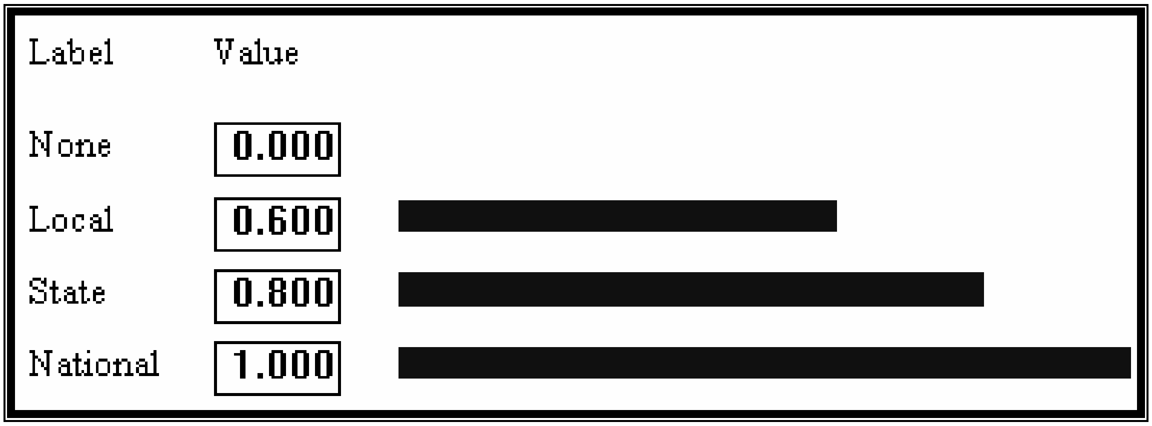
Category	Category Definition	Value
None	Requirement to locate utility lines, adhere to the base excavation permit process, and maintain and provide record drawings not addressed in the proposal.	0.0
Minimal	Proposal acknowledges and addresses the requirements to locate utility lines, adhere to the base excavation permit process, and maintain and provide record drawings (RFP Sections C.5.1, C.9.5, and C.9.6).	0.6
Good	Proposal expands to address specific plan of action and responsibilities for locating utility lines, conforming to base excavation permit process, and maintaining and providing record drawings.	0.8
Exceptional	Proposal includes all previous and also addresses proposed time requirements/standards that contractor will meet for each activity.	1.0

M10: Best Engineering and Management Practices Adequately Addressed



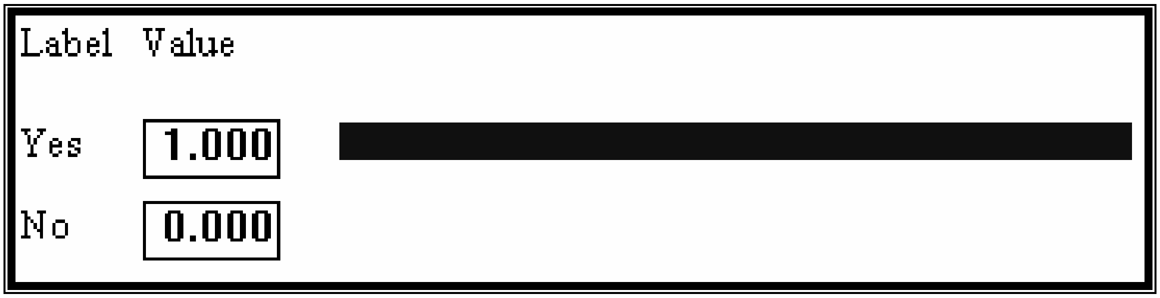
Category	Category Definition	Value
None	Use of Best Engineering and Management Practices not addressed in the proposal.	0.0
Minimal	Proposal acknowledges and addresses the requirement to utilize Best Engineering and Management Practices consistent with Publications listed in RFP Section L.6.2 to include a quality philosophy based on accepted management practices and a proven system of inspections and other quality assessment procedures and techniques, procedures, and performance metrics and standards. (RFP Sections L.6.2 and M.4.2.2).	0.6
Good	Proposal expands to address specifically how their quality philosophy will be applied to daily operations of the system.	0.8
Exceptional	Proposal includes all previous and also addresses plan for modifying service practices to initiate and facilitate continuous improvement processes.	1.0

M11: Level of Awards and Certificates



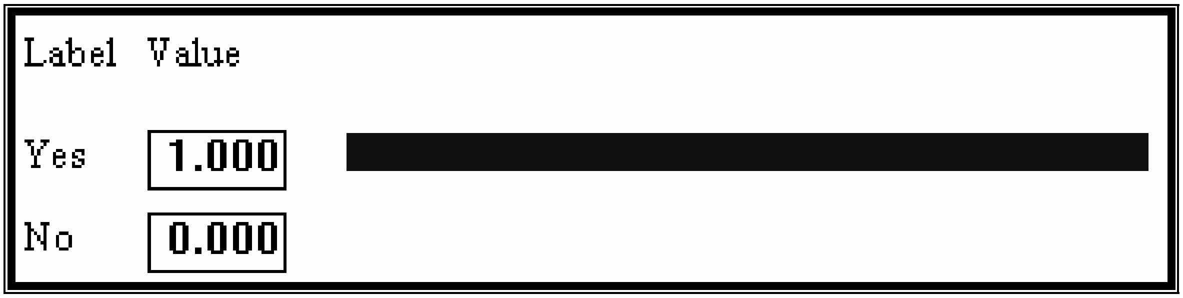
Category	Category Definition	Value
None	No Quality Awards or Quality Certificates received at any level (RFP Sections L.6.2 and M.4.2.2).	0.0
Local	Quality Awards or Certificates received at the local level (highest level).	0.6
State	Quality Awards or Certificates received at the state level (highest level).	0.8
National	Quality Awards or Certificates received at the national level (highest level).	1.0

M12: Certification of Employees Adequately Addressed



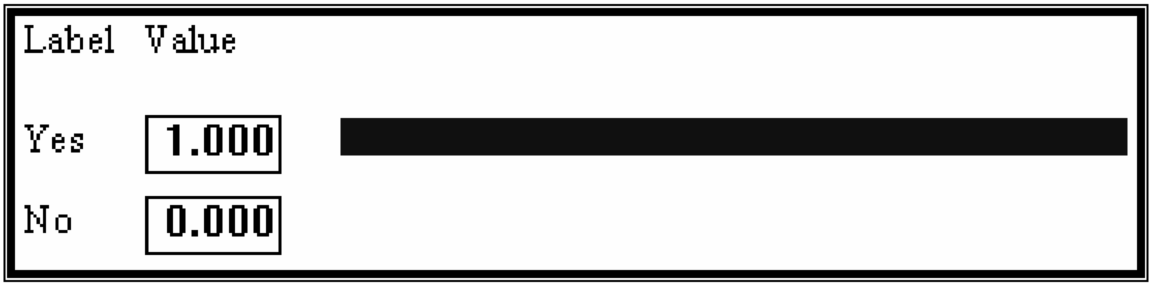
Category	Category Definition	Value
No	Certification of employees hired by the contractor is not addressed in proposal.	0.0
Yes	Proposal addresses certification of employees including discussions on how they will ensure proper skill levels of workers and what training and certifications are required for each job.	1.0

M13: English Skills of Employees Adequately Addressed



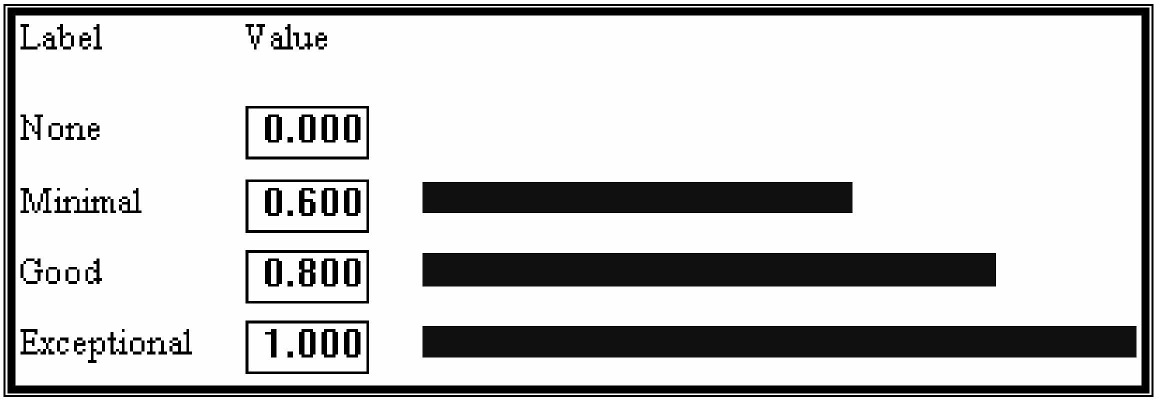
Category	Category Definition	Value
No	English skills of employees hired by the contractor are not addressed in proposal.	0.0
Yes	Proposal addresses English skills of employees including discussions on how they will ensure proper skill levels of workers and what skill levels are required for each job.	1.0

M14: National Agency Check Information Gathering and Providing Adequately Addressed



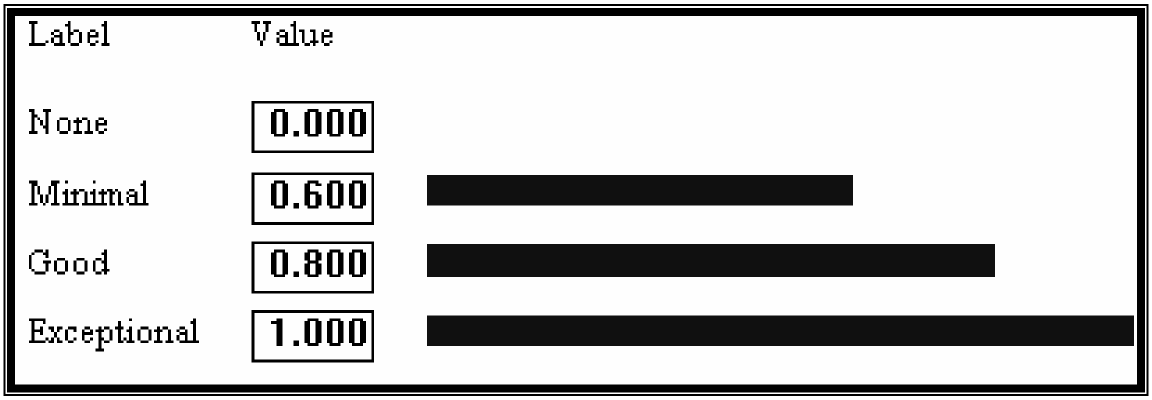
Category	Category Definition	Value
No	The gathering and providing of NAC information on employees hired by the contractor is not addressed in proposal.	0.0
Yes	Proposal addresses the procedures that will be used for gathering and providing NAC information on employees hired by the contractor.	1.0

M15: Capital Upgrades and Renewals and Replacements Plan Adequacy



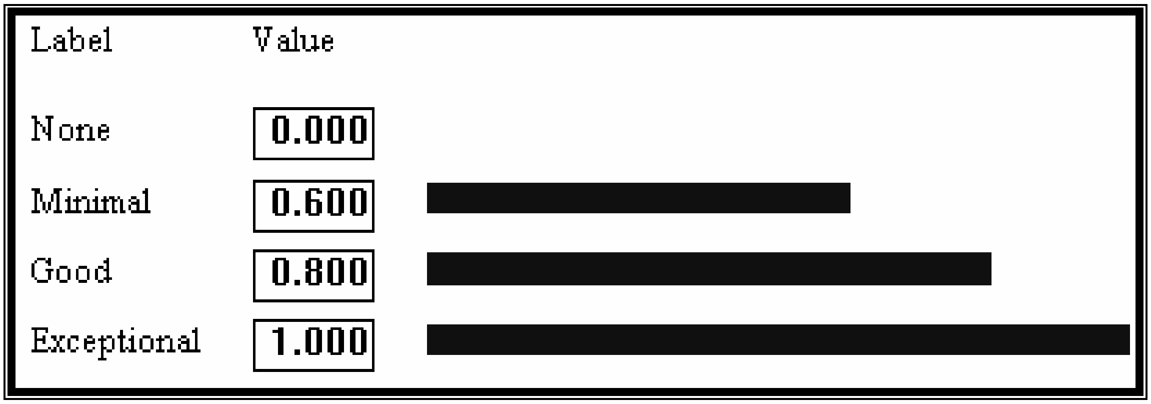
Category	Category Definition	Value
None	Capital Upgrades and Renewals and Replacements Plan not included in the proposal.	0.0
Minimal	Proposal describes in detail the purpose, scope, and benefit of the initial renewals and replacements as well as a detailed description of the contractor's philosophy towards long-term capital upgrades and renewals to include as a minimum the items listed in RFP Section L.6.3 (Also ref. RFP Sections C.11.2 and C.13).	0.6
Good	Proposal expands to address specific plans for upgrades that will increase the overall efficiency of the system.	0.8
Exceptional	Proposal includes all previous and exceeds requirements in a way beneficial to the government.	1.0

M16: Hazardous Materials and Hazardous Waste Minimization Adequately Addressed



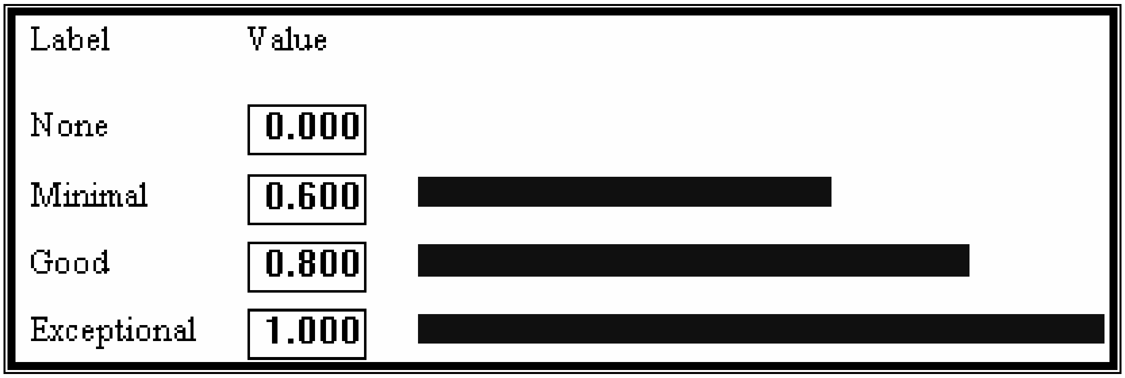
Category	Category Definition	Value
None	Hazardous materials and waste minimization not addressed in the proposal.	0.0
Minimal	Proposal acknowledges and addresses the requirement to handle hazardous materials in accordance with applicable laws and regulations and RFP Sections C.10.3 and H.8.	0.6
Good	Proposal expands to identify non-hazardous or less hazardous materials than those currently in use that contractor proposes to use.	0.8
Exceptional	Proposal includes all previous and also gives detailed plans for consumable hazardous waste recycling plan.	1.0

M17: Service Providance Adequately Addressed



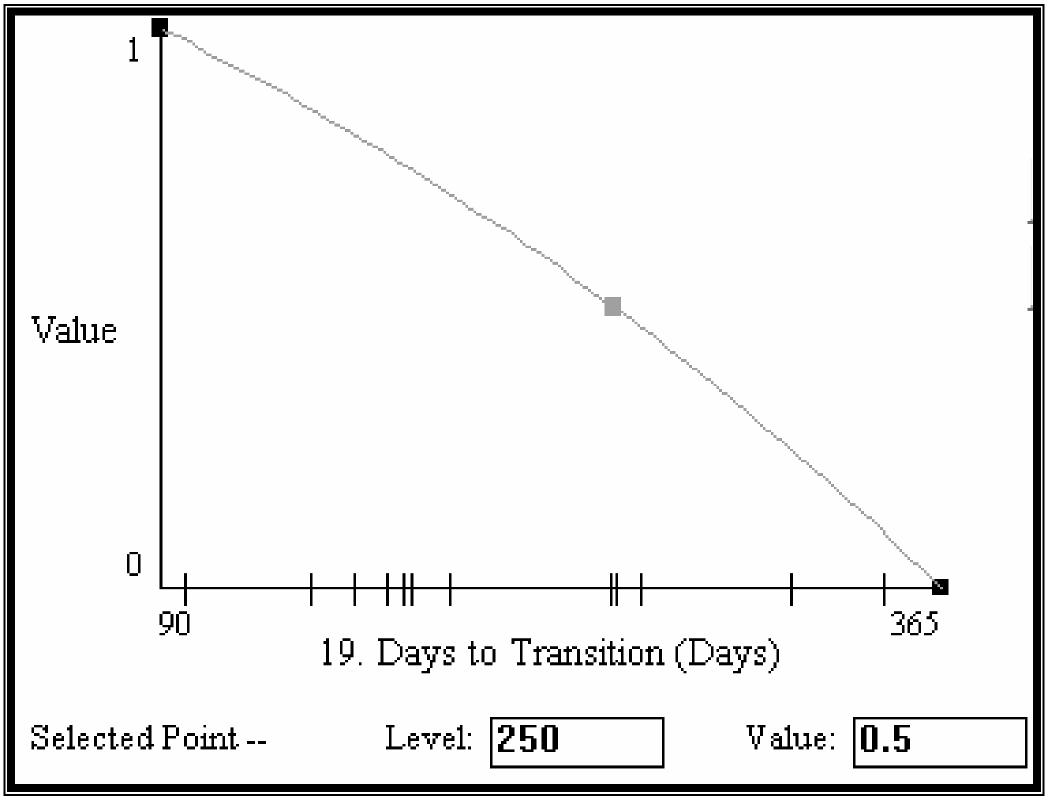
Category	Category Definition	Value
None	Service requests and responses, connections and disconnections, and service interruptions are not addressed in the proposal.	0.0
Minimal	Proposal adequately addresses routine, urgent, and emergency service requests, connections and disconnections, and scheduled service interruptions in accordance with RFP Sections C.8 and C.9.	0.6
Good	Proposal expands to include listing of workarounds for specific scheduled service interruptions.	0.8
Exceptional	Proposal includes all previous and exceeds service requirements in a way beneficial to the government.	1.0

M18: Spill Contingency Plan Adequacy

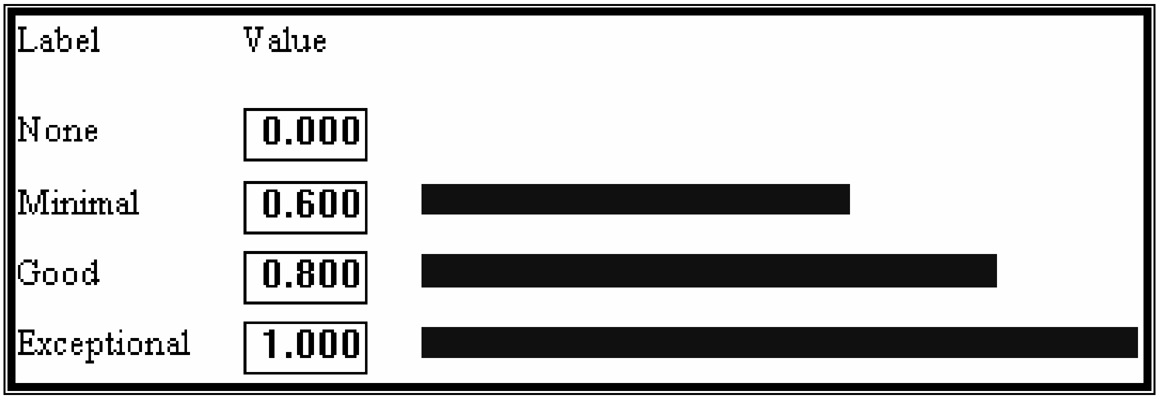


Category	Category Definition	Value
None	Spill contingency plan not included in the proposal.	0.0
Minimal	Proposal includes adoption of the Installation Spill Contingency Plan or use of a USAF accepted, contractor developed Spill Contingency Plan developed in accordance with the National Response Team's Integrated Contingency Plan Guidance.	0.6
Good	Proposal expands to include listing of mission essential workarounds for spill contingency responses.	0.8
Exceptional	Proposal includes all previous and procedures for regularly scheduled spill contingency exercises.	1.0

M19: Days to Transition

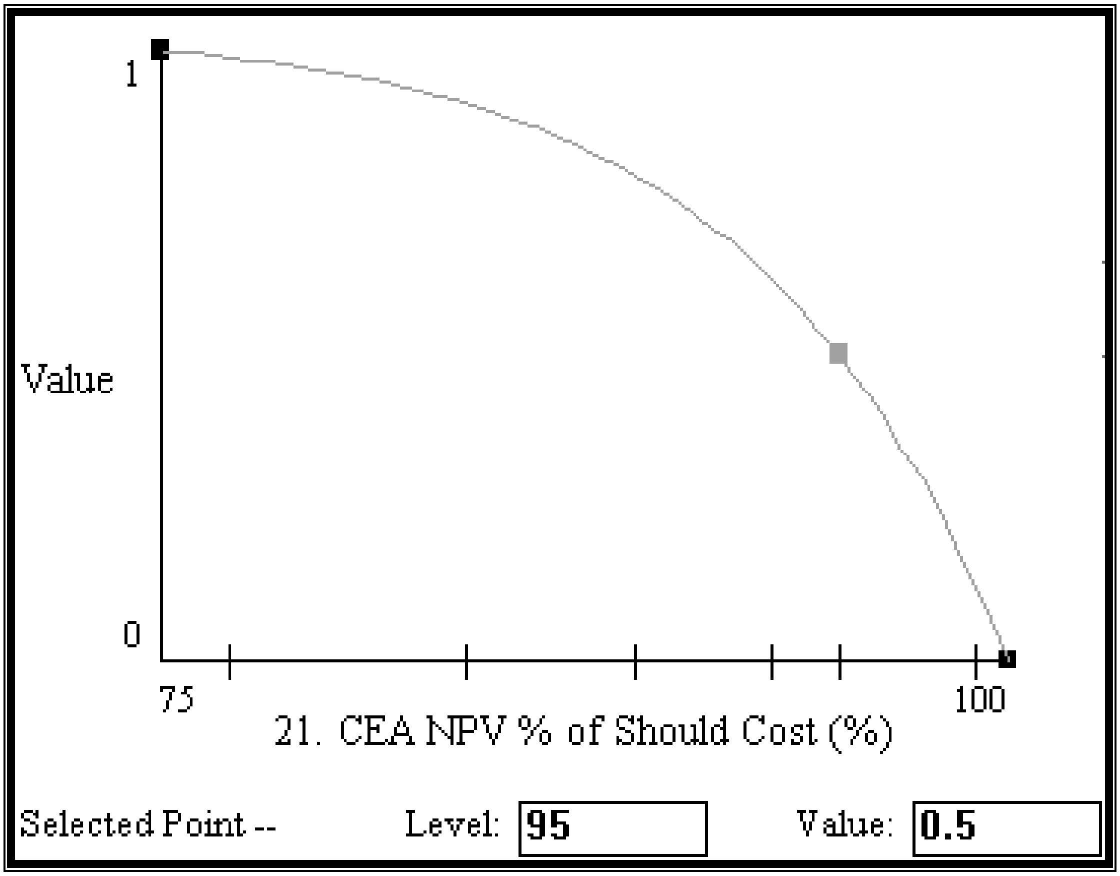


M20: Transition Plan Adequacy

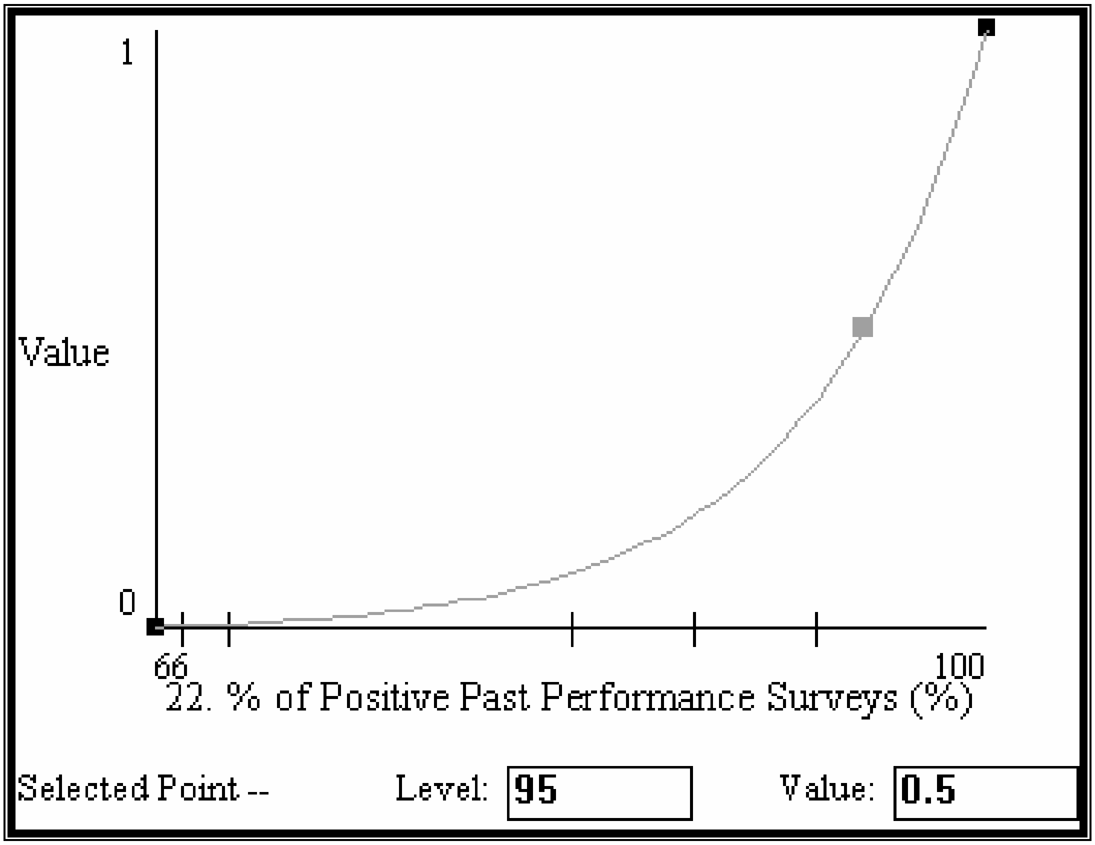


Category	Category Definition	Value
None	Transition plan not included in the proposal.	0.0
Minimal	Proposal included transition plan addressing hiring of work force, acquisition of equipment and materials, operations testing, environmental surveys, obtaining of permits, construction, maintenance, improvements, new connections and meters, and elimination of safety hazards in accordance with RFP Sections C.13, L.6.4, and M.4.2.4.	0.6
Good	Proposal expands to include approved and coordinated weekly meeting schedule with the Contracting Officer's representative during transition period.	0.8
Exceptional	Proposal includes all previous and detailed explanation of how contractor proposes to specifically minimize service impacts for all base organizations.	1.0

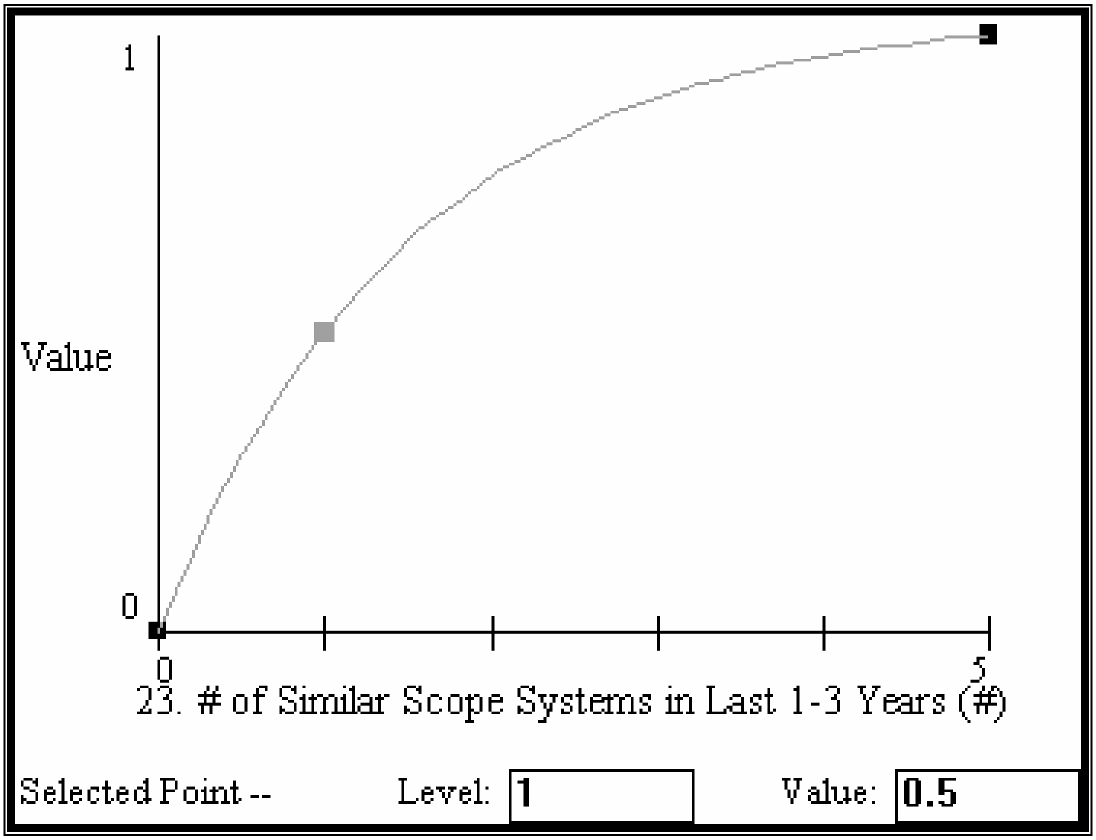
M21: Certified Economic Analysis Net Present Value as a % of Government Should Cost Estimate



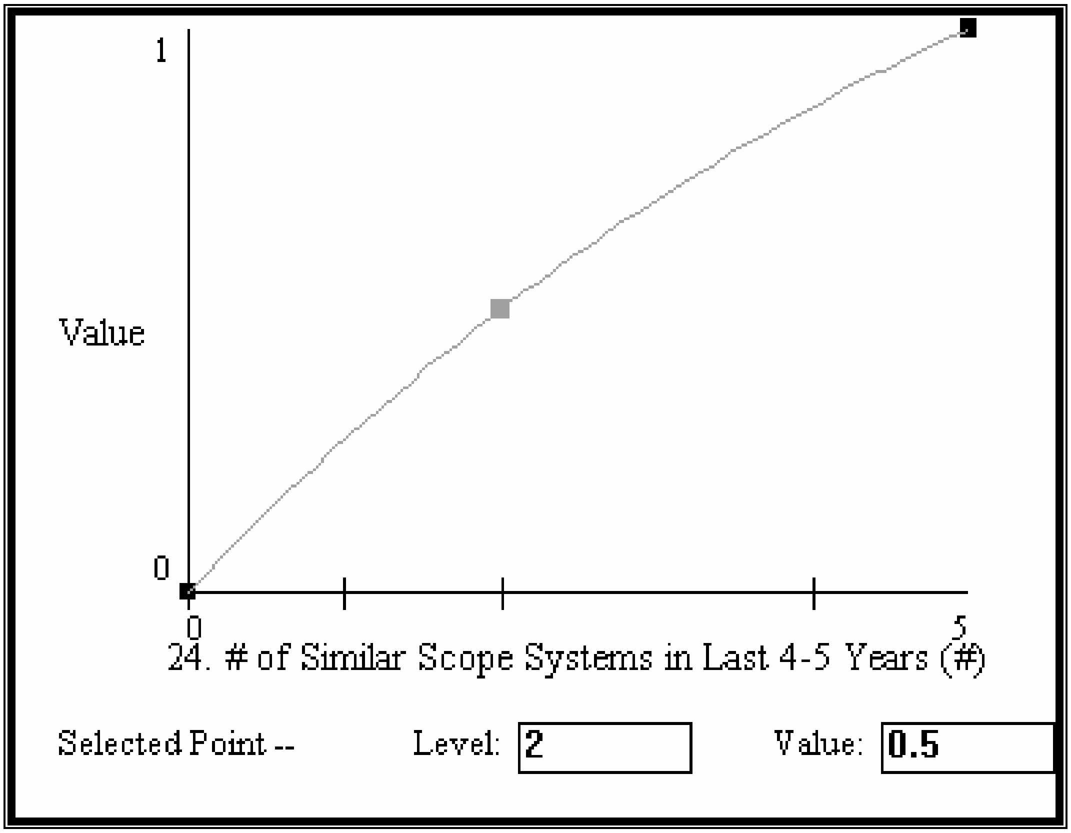
M22: % of Positive Past Performance Surveys



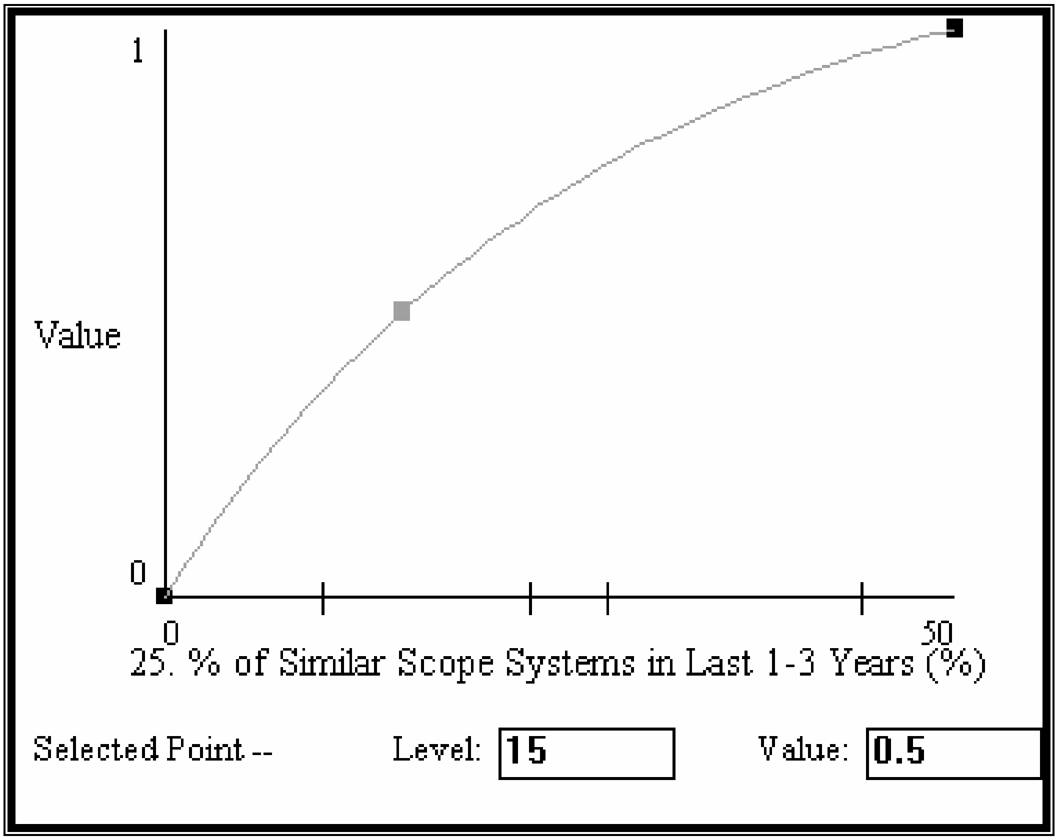
M23: # of Similar Scope Systems in Last 1-3 Years



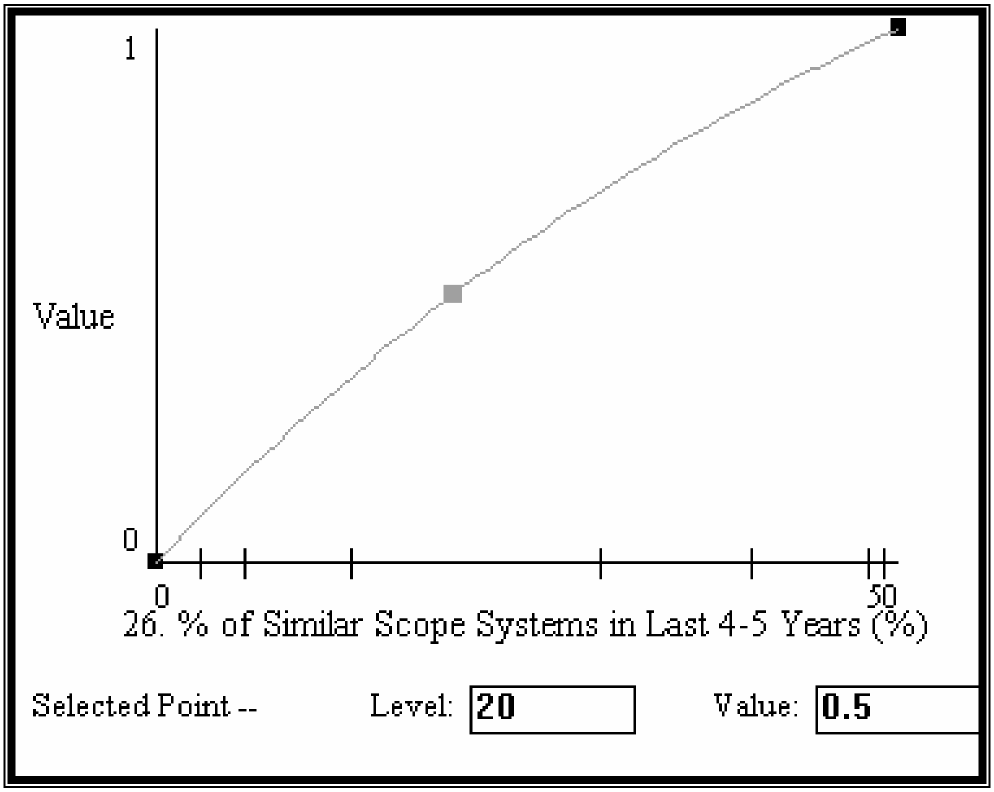
M24: # of Similar Scope Systems in Last 4-5 Years



M25: % of Similar Scope Systems in Last 1-3 Years



M26: % of Similar Scope Systems in Last 4-5 Years



Appendix C. Alternative Scores

Alt. #	Prop. #	M1	M2	M3
A1	**P89**	Unconditionally Qualified	Unconditionally Qualified	Conditionally Qualified
A2	**P389**	Conditionally Qualified	Unqualified	Conditionally Qualified
A3	**P488**	Unconditionally Qualified	Conditionally Qualified	Unqualified
A4	**P260**	Unconditionally Qualified	Unconditionally Qualified	Unconditionally Qualified
A5	**P354**	Conditionally Qualified	Conditionally Qualified	Conditionally Qualified
A6	**P285**	Unconditionally Qualified	Unconditionally Qualified	Unconditionally Qualified
A7	**P83**	Unconditionally Qualified	Unconditionally Qualified	Unconditionally Qualified
A8	**P297**	Unconditionally Qualified	Conditionally Qualified	Unqualified
A9	**P216**	Unconditionally Qualified	Unqualified	Unqualified
A10	**P333**	Conditionally Qualified	Conditionally Qualified	Unqualified

Alt. #	Prop. #	M4	M5	M6	M7
A1	**P89**	Unconditionally Qualified	Conditionally Qualified	Exceptional	Good
A2	**P389**	Unqualified	Unconditionally Qualified	Minimal	Exceptional
A3	**P488**	Conditionally Qualified	Conditionally Qualified	Minimal	Good
A4	**P260**	Unconditionally Qualified	Unconditionally Qualified	Good	Good
A5	**P354**	Conditionally Qualified	Unconditionally Qualified	Exceptional	Good
A6	**P285**	Unqualified	Conditionally Qualified	Minimal	Minimal
A7	**P83**	Unconditionally Qualified	Unqualified	Exceptional	Minimal
A8	**P297**	Conditionally Qualified	Conditionally Qualified	Minimal	None
A9	**P216**	Unqualified	Unqualified	Minimal	Good
A10	**P333**	Unconditionally Qualified	Unconditionally Qualified	Good	None

Alt. #	Prop. #	M8	M9	M10	M11	M12	M13	M14	M15
A1	**P89**	Exceptional	None	Minimal	National	Yes	Yes	Yes	Exceptional
A2	**P389**	Minimal	None	Exceptional	State	No	Yes	No	Exceptional
A3	**P488**	None	Minimal	Good	State	Yes	Yes	No	Minimal
A4	**P260**	Good	Good	Minimal	None	Yes	Yes	No	None
A5	**P354**	Exceptional	Exceptional	Exceptional	State	Yes	No	Yes	Good
A6	**P285**	Exceptional	Good	Exceptional	State	Yes	Yes	Yes	Exceptional
A7	**P83**	Minimal	Exceptional	Good	Local	No	Yes	No	None
A8	**P297**	None	None	Good	National	Yes	No	No	Minimal
A9	**P216**	Exceptional	None	None	None	Yes	Yes	No	Minimal
A10	**P333**	Minimal	Good	Exceptional	State	No	No	No	Good

Alt. #	Prop. #	M16	M17	M18	M19	M20	M21	M22	M23	M24
A1	**P89**	Exceptional	Exceptional	Exceptional	102	Exceptional	92	68	2	4
A2	**P389**	Minimal	Exceptional	Minimal	244	None	75	68	5	5
A3	**P488**	None	Minimal	Minimal	270	None	97	100	4	4
A4	**P260**	Exceptional	Exceptional	Good	158	Exceptional	97	66	4	0
A5	**P354**	Minimal	Good	None	329	Good	86	85	0	1
A6	**P285**	Exceptional	Minimal	Exceptional	107	Exceptional	75	94	0	4
A7	**P83**	Exceptional	Exceptional	Exceptional	292	Good	75	80	5	2
A8	**P297**	Minimal	Minimal	Good	90	Exceptional	93	80	4	4
A9	**P216**	None	Exceptional	Exceptional	232	Minimal	76	100	1	5
A10	**P333**	Exceptional	Exceptional	Exceptional	96	Good	99	75	3	1

Alt. #	Prop. #	M25	M26
A1	**P89**	31	46
A2	**P389**	45	9
A3	**P488**	46	28
A4	**P260**	33	33
A5	**P354**	1	31
A6	**P285**	20	23
A7	**P83**	31	7
A8	**P297**	0	47
A9	**P216**	27	44
A10	**P333**	50	46

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Vita

Captain Heath Duncan was born in Great Bend, Kansas. In 1993 he graduated from Ottawa High School in Ottawa, Kansas, and entered the United States Air Force Academy in July of that same year. He earned a Bachelor of Science degree in Civil Engineering and was commissioned in May 1997.

Captain Duncan's first assignment was to McConnell AFB, Kansas. At McConnell AFB, he served as the executive officer for the 350th Air Refueling Squadron until February, 1998. His next assignment was to Vance AFB, Oklahoma, where he attended Undergraduate Pilot Training and served as the executive officer for the 71st Logistics Readiness Squadron until June, 1998. Captain Duncan then entered the Civil Engineering career field and was assigned to Tinker AFB, Oklahoma. While at Tinker, he served as a project programmer for the 72nd Civil Engineer Group. In June of 1999, Captain Duncan left Tinker for his next assignment at Hurlburt Field, Florida. At Hurlburt he served as a project engineer for the 823rd RED HORSE Squadron. He then entered the Engineering Management Program, Graduate School of Engineering and Management, Air Force Institute of Technology in August of 2002. Following graduation, Captain Duncan will be assigned to the 509th Civil Engineer Squadron, Whiteman AFB, Missouri.

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14. ABSTRACT

The Department of Defense's utility systems have suffered from under-funding and lack of technology investment, thereby creating a service gap between these DoD systems and systems operated by commercial providers. In order to overcome this gap and refurbish their systems, the DoD has focused its efforts on privatization of these systems. The utilities privatization decision is extremely vital and "permanent" and thus warrants backup source selection methodologies.

Since awarding contracts in the utilities privatization arena requires a decision considering tradeoffs between multiple competing objectives, a value-focused thinking approach was used to create a structured, standardized value model taking into account the values of the United States Air Force with regard to utilities privatization. This model was then used to evaluate a set of randomly generated contractor proposals for leasing an Air Force owned electrical system and perform deterministic and sensitivity analysis on the recommended decision generated by the model.

The results of this research provide a quantitative, objective, reliable, and defendable tool for a utilities privatization source selection decision. The value model is generic enough for evaluating the source selection decision of any utility system, but is able to accommodate changes in guidance, decision makers, and other factors.

15. SUBJECT TERMS

Value Focused Thinking, Utilities Privatization, Source Selection

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